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ABSTRACT

Based on the expertise generated by years of work in minority engineering program development, this handbook consolidates the experiences of program directors, industry sponsors, and school system collaborators. Its purpose is to provide quidelines for setting up a comprehensive precollege engineering program. Discussions include: (1) history; (2) assessing community needs; (3) assembling support teams; (4) organizational structure; (5) starting up; (6) program administration; and (7) public relations. Appendices include directories of program administrators, lists of resources, publications, and program models, statistics on minority engineering enrollment and academic preparedness of high school students, directions for writing a program proposal, and definitions and illustrations of operational plans. (CW)

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Gearing Up:

How to Start a Precollege Minority Engineering Program

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Gearing Up:

How to Start a Precollege Minority Engineering Program

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Acknowledgments

Gearing Up is based on the expertise generated by years of work in minority engineering program development. It consolidates the experiences of program directors, industry sponsors, school system collaborators and NACME's own field services staff.

For his work in distilling this massive body of knowledge into a comprehensible step-by-step guide, NACME's appreciation and sincere thanks go to Arthur Poole, director of field services.

Thanks, too, go to Ronni Denes, director of communications, who coordinated the project, revised its many drafts, and was responsible for its publication.

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Preface

> *The nation is not being adequately served by current efforts to increase the number of women and minorities in the science and engineering workforce. Unless these efforts are maintained where they are effective and intensified where they are not, the nation will continue to deprive itself of an important source of future scientists and engineers.*
>
> *"Undergraduate Science, Mathematics, and Engineering Education"*
> *National Science Board, 1986*

Welcome to one of the most exciting educational initiatives in America, the Minority Engineering Education Effort. This movement was founded almost 15 years ago to increase the number of underrepresented minorities—Blacks, Mexican Americans, Puerto Ricans, and American Indians—who earn bachelor's degrees in engineering. Acting as both catalyst and coordinator for this coast to coast effort is the National Action Council for Minorities in Engineering, better known as NACME.

■ Why the focus on pre-engineering education?

In today's economy, creating access to technological careers for minority students is more than an ethical responsibility. It is NACME's belief, as well as that of our founders and supporters, that this country cannot thrive in the world market without tapping the talents of all our youth.

NACME's role is to facilitate their passage along the entire educational trajectory from junior high through high school and engineering college. Accordingly, NACME developed this handbook to encourage, guide and assist you—educators, business leaders, community activists and all interested others—to initiate programs for minorities in engineering at junior and senior high schools throughout the country. By exposing students at an early age to the opportunities offered by a career in engineering, NACME hopes to motivate, attract and prepare more minorities to make a successful contribution to the field and to the society at large.

This handbook gives you guidelines for setting up a comprehensive precollege engineering program in your community. Based on expertise accumulated during many years of program development, the model we propose offers minority students a mix of services that are motivational, informational, and academically enriching. It is designed and implemented as a long-term, ongoing intervention that enhances instruction already provided by the schools. While such programs can be established independently, we have found that they have greater impact when operated in partnership with the local school system.

Our guidelines describe programs aimed at junior and senior high school students, although in recent years several precollege minority programs around the country have instituted components at the elementary school level. Certainly, much of what is presented here can be adapted to the early grades. The importance of improving science and math instruction for minorities at this age cannot be underestimated. According to the National Science Foundation:

> *Research has demonstrated the clear and lasting impact of early learning—not only as a base for further education, but also for establishing patterns of study, talent, reasoning, and curiosity. This is particularly true in the sciences, where stimulation of intellectual curiosity and an early introduction to important principles and concepts is critical to later success.*

Those of you who undertake the commitment to introduce minority students to the wonders and opportunities of engineering join many others throughout the country in what has become a national crusade.

So that you know the origins of the movement and appreciate its tradition, we begin in Chapter One with a historical overview of the Minority Engineering Education Effort.

In Chapters Two and Three, we will discuss the first steps to setting up a minority precollege engineering program, "Assessing the Needs of Your Community" and "Assembling Your Support Team." The next steps, "Structuring the Organization" and "Getting Started," are covered in Chapters Four and Five. And Chapter Six, "Administering the Program," will provide guidelines for the last of your pre-implementation activities.

To help you while you're developing and organizing your program, we've included an extensive appendix that provides lists of resource organizations, forms to carry out needs assessment, and pertinent statistical information to validate your claims and your requests. As you read this handbook, keep in mind that NACME's field service staff is ready to assist you in any way it can.

Chapter One: A Historical Perspective

1

> *The changing student demographics of the coming decade have several important implications for national policy...It becomes especially important to utilize all potential human resources to the fullest extent possible. This means that increasing attention should be paid to those groups with historically weak participation rates in science and engineering...The increasing fraction of college students that will be drawn from the Black and Hispanic populations, which have historically participated in science and engineering education and employment at far lower rates than the white population, imply that programs aimed at increasing the participation of these two minority groups could be an especially important source of new talent.*

This was one of several major conclusions reached by the Office of Technology Assessment (OTA), a research agency of the U.S. Congress, in a December 1985 study.[1]

Corporate leaders foresaw these demographic trends and the need to address the underutilization of a large and potentially dynamic pool of human resources more than a decade earlier.

In 1973, a small group of top executives from some of the nation's major corporations brought together leaders from industry, government, education, professional engineering societies and minority organizations to discuss the "woefully insufficient" supply of minority engineers. This group decided to launch a massive national effort to achieve proportional representation or "parity" for minorities in engineering.

The result has been a unique merging of diverse interests and activities at the local and national levels working toward one common goal—to increase the number of Black, Mexican American, Puerto Rican, and American Indian students graduating from college with degrees in engineering. This initiative is known as the Minority Engineering Education Effort.

■ Why is it so important to get minorities into engineering?

"It is no exaggeration," notes the 1985 National Research Council's Committee on the Education and Utilization of Engineers, *"that the profession has the same impact on the nation's social and economic health as the medical profession has upon its physical health."*[2]

There's no doubt that engineering is responsible to a great extent for creating and maintaining the American way of life. It has provided the manufacturing processes, highways and bridges, ground and air transportation systems, telephone and power utilities, water treatment and distribution, and waste treatment and management that perform efficiently, safely and reliably at low cost to create the high standard of living that this country takes so much for granted. This responsibility becomes ever more challenging as the service sector of our economy grows and our nation's share of international markets shrinks.[3]

At the same time, engineering provides the technology for standards development and testing that enables government and industry to protect national resources and ensure public health and safety. Engineering has also played a primary role in establishing our nation's defense capability, a role that becomes increasingly demanding as the dependence on technology in modern weapons grows.

It's not difficult to imagine what the future holds if as a nation we fail to seek out and nurture the next generation and successive generations of scientists, engineers and technicians. With demographers predicting that by the year 2000 one of every three Americans will be minority, we face serious threats to our economic growth and military security, and indeed, our preeminence as a world power.

In the last fifteen years, substantial progress has been made in increasing the number of minority engineers. In 1970, it was estimated that only one percent of graduating engineers were Blacks, and that minorities constituted just over two percent of the general engineering work force. By 1985, the proportion of graduating engineers had grown by nearly 400 percent, and participation in the work force tripled.[4] (Comprehensive statistics are included in Appendix F-1.) Despite these impressive gains, minorities still constituted only five percent of the graduating engineers in June 1986.

Of course, not all of this progress can be attributed solely or directly to the Minority Engineering Education Effort. Social change over the last 20 years has certainly made education more widely available throughout American society. Yet, the role our effort has played in advancing the educational attainments of minority students is widely acknowledged—by the students themselves, by engineering colleges, corporations, government agencies, and academic researchers.

A great deal still remains to be done. Unfortunately, the prospects for the future of minorities in engineering are not quite so rosy. Statistics show that minority college enrollments in general, and minority enrollments in engineering in particular, have leveled off or declined somewhat in recent years.

Since reaching its peak in 1981, freshman minority engineering enrollment has declined by nearly five percent. Figure 1:1 is a composite look at the growth of minority and total engineering enrollments between 1973 and 1985.

The relatively low average annual growth rate of minorities graduating with degrees in engineering can be attributed to the fact that many entering freshmen students fail to complete their degrees. Overall, engineering students graduate at a rate of approximately 70 percent, while minorities graduate at about 35 percent.

■ Why are there fewer minority students graduating in the field of engineering?

A 1978 national symposium on minorities in engineering titled "Phase 2: Building the Multiplier Effect" identified what continue to be two major obstacles to the development of a significant pool of minority engineering students. They are:

1. Lack of motivation

Science and math-oriented professions historically have had low visibility in minority communities. Children grow up with little if any exposure to the role models that inspire and motivate young minds to strive for scientific and technological careers. Misconceptions about the field of science and what a scientific education entails are common. As a consequence, minority communities often harbor negative social perceptions of scientists and engineers, and of their work.

At the same time, society at large imposes its view that certain intellectual endeavors, particularly in the scientific fields, are beyond the inherent capabilities of the average minority student.

Figure 1.1

■ Engineering Enrollments: Growth Rates From 1973 to 1985

Total Growth %	Item	Average Annual Growth Rate %*
371	Number of freshman minority students enrolled full time in engineering	13.8
331	Number of all minority students enrolled full time in engineering	12.9
209	Number of minority engineering graduates	9.9
136	Minority percentage of all freshman students enrolled full time in engineering	7.4
107	Total full-time enrollment in engineering	6.2
102	Minority percentage of all students enrolled full time in engineering	6.1
100	Total full-time freshman enrollment in engineering	5.9
81	Total engineering graduates	5.1
72	Minority percentage of engineering graduates	4.6

*These percentages are rounded to the nearest tenth.

2. Lack of adequate academic preparation

Many minority students attend elementary and secondary schools that, regardless of the students' degree of motivation, are not adequately equipped to prepare them. Such schools lack quality curriculum, effective instruction, sufficient financial resources, or some combination of the three.

Other minority students may fail to enter or to master a secondary school program prerequisite to the study of engineering at the college level. (See *Mathematics and Science: Critical Filters for the Future of Minority Students*[5] for a full discussion on the factors that influence minority student participation and performance.)

Clearly, enhancing the motivation and academic preparation of minority students at the precollege level is of utmost importance in establishing a large pool of potential minority engineers. The Minority Engineering Education Effort has been slow to respond to this need.

Initially, the effort concentrated both energy and dollars on college level intervention. It worked to recruit able minority high school students into engineering schools by providing financial aid to meet the cost of acquiring an engineering education, and by providing services to support the student, once enrolled.

With experience, the effort recognized that if it were to reach its goal of increasing the number of minorities in the engineering profession, it would have to focus on building the total pool of academically qualified minority students. This meant enhancing the educational preparation of all minority students, while simultaneously combatting the negative social and community attitudes that limited their aspirations.

Improved education, inspired by the acknowledged social and economic demands that we "utilize all potential human resources to the fullest extent possible" will undoubtedly propel minorities closer to the goal.

■ What is a precollege minority engineering program?

A good precollege minority engineering program is one of the most exciting interventions now available to secondary school students. While created primarily to "identify promising minority students, to motivate and help them qualify for engineering studies, and work to change existing systems so that the need for special programs diminishes and eventually disappears,"[6] in effect they bring the magic of new aspirations and abilities to an often stagnant curriculum.

Although existing precollege minority engineering programs may differ in organizational structure, funding mechanisms, and the services they provide, they are all educational enrichment programs—for the minority student in particular—and for the minority community in general. How such a program can enrich the community is described by Ralph Kramer and Harry Specht, editors of *Readings in Community Organization Practice*.

Community organization is the process of working with individuals or groups in a community to bring about social change through various methods of intervention. The targets of most community organizational efforts are social institutions and environmental conditions. There are two steps to accomplishing social change. The first is identifying the problem, diagnosing causes and formulating solutions. The second is developing the strategies and mobilizing the resources necessary to bring about the change.[7]

Effective precollege minority engineering programs enrich the student and community by intervening in the cycle of minority isolation, low self-esteem, low teacher expectations and poor academic performance. They counter the underdevelopment of minority students with strategies designed to break down the obstacles to achievement in scientific and technological fields.

- **What kinds of math and science intervention programs are effective in enhancing minority student achievement?**

NACME's decade-plus experience providing assistance to precollege programs has defined specific components that most often foster success. Many of these are also identified by NAPD, the National Association of Precollege Directors in its book, *Promoting Success Through Collaborative Ventures in Precollege Science and Mathematics*. Independent verification comes from DeAnna Banks Beane who combed existing research in the field to find effective program characteristics, delivery strategies, and resource utilization techniques.[8]

Characteristics of Effective Math and Science Programs:

- a clearly articulated objective, e.g., to encourage the target group to move into math/engineering/science-based careers
- clearly articulated short-term and long-term goals
- the identification and implementation of specific intervention strategies
- institutionalized program strategies that assure the maintenance of increased levels of minority student participation and performance
- the support of school administrators who are committed to the program objective and frequently act as facilitators
- teachers who have high expectations for the achievement of all students
- teachers who are subject matter competent
- role models who come from minority population groups
- guidance counselors who provide accurate college and career counseling for science, mathematics, and engineering to all students
- a plan for involving parents

Strategies of Math and Science Intervention Programs:

- provide an integrated approach to mathematics and science curricula by having teachers of both disciplines work cooperatively
- integrate mathematics and science curricula into other subject areas, e.g., having math and science provide the content for a communications component focusing on writing and speaking skills
- provide a sequential curriculum that prevents "content/skill gaps," especially in mathematics
- develop peer support systems
- encourage students to work in teams, a technique that seems to be more compatible with the personal style of the targeted population
- emphasize utility and practical applications of science and mathematics as opposed to heavy reliance on theory
- focus on higher level cognitive skills related to problem solving, understanding, and applications
- focus on enrichment activities, emphasizing the scientific process over the simple accumulation of knowledge
- provide a "hands on" laboratory activity orientation
- focus on real-life problems that incorporate the interests and concerns of the targeted group

Effective Utilization of Community Resources:

- establish cooperative ventures between schools and local universities, such as Saturday academies or summer enrichment programs
- create links with business and industry to facilitate funding, in-kind contributions, and accessibility to engineering plants and personnel

- contact local professional organizations for motivational materials and role models

■ To what degree have precollege minority engineering programs achieved their objectives?

Based on the experience of existing precollege minority engineering programs, we find overwhelming evidence that programs like these have successfully enhanced the motivation and academic preparation of minority students.

One example is the Southeastern Consortium for Minorities in Engineering, better known as SECME. In 1975, representatives from seven colleges of engineering in the southeastern United States met to organize a program that would increase, on a long-term basis, the number of minority students interested in and qualified for the study of engineering.

The SECME program places great emphasis on improving the quality of classroom content and instruction. At its Summer Institutes, SECME trains teachers, guidance counselors and administrators from affiliated school systems in new curricula and new instructional techniques designed to motivate students to learn.

When SECME-trained educators return to their schools in September, they are better prepared to instruct college-bound students in communication skills as well as the math and science courses that are essential to the study of engineering.

Many of the teachers' classroom aids—educational modules and equipment—are furnished by SECME sponsors and affiliated institutions. Career education and guidance, excursions to engineering sites and other field trips, and classroom visits from practicing engineers are also components of the SECME program.

SECME gets results. In 1984 and 1985, the Scholastic Aptitude Test (SAT) scores of graduating Black seniors who were pre-engineering students enrolled in SECME programs were about 200 points higher than those of non-SECME Black students. Supporters use such statistics to demonstrate that interventions like theirs can close and perhaps eventually eliminate the performance gap between majority and minority students on this college entrance requirement test.

Figure 1.2 illustrates SECME's accomplishments in the area of SAT achievements.

Figure 1.2

■ SECME and Comparative SAT Score Averages

	1985			1984		
	Verbal	Math	Total	Verbal	Math	Total
All Students	431	475	906	426	471	897
White	449	491	940	445	487	932
Black	346	376	722	342	373	715
Mexican American	382	426	808	390	427	817
Puerto Rican	368	409	777	366	400	766
American Indian	392	428	820	390	427	817
SECME*	436	488	924	420	501	921

*Black pre-engineering student participants only

Sources: Professional Women and Minorities: A Manpower Data Resource Service (Commission on Professionals in Science and Technology: Washington, D.C., 1986). Table 1-5, p. 10.

Various SECME newsletters.

SECME's success has bred admirable expansion. Incorporated in 1976, the Consortium is now an affiliation of 24 institutions with undergraduate majors in engineering. As of Fall 1986, SECME programs were operating in 197 junior and senior high schools in 57 public school systems in six southern states.

Another very successful precollege minority engineering program is the California Mathematics, Engineering, and Science Achievement program or MESA. It was conceived in 1968 by the faculty and student services staff at the University of California who were concerned that so few Black and Chicano students were enrolling in mathematics and scientific fields, particularly engineering.

In February 1970, with a small foundation grant, a committee of secondary and postsecondary school faculty started what is now the MESA program with 12 students at an Oakland high school. The program included motivational workshops for the students, field trips, academic guidance and tutoring. MESA expanded to two other high schools in 1972 after a preliminary evaluation showed that its strategy of providing motivational and academic support to ethnic minority students was effective.

Encouraged to expand further by its foundation supporters, MESA hired a full-time executive director and support staff in 1977. Two years later, MESA successfully persuaded the California State Legislature to provide funding for programs to serve the growing number of ethnic minority students in the state's public schools. By March 1986, MESA's precollege program operated in 160 California junior and senior high schools serving a population of more than 4,000 students.

The performance of MESA students also soared past that of their classmates as measured by SAT scores and other indicators of academic success. A 1983 study of academic performance among more than 12,000 college-bound Black, Mexican American, Puerto Rican, and American Indian students completing SATs compared those who participated in MESA with those who did not. The results are presented in Figure 1:3.

The MESA model is so successful it has been replicated in at least seven other states.

Figure 1:3

■ MESA—Non-MESA Student Performance Comparisons

MESA	Non-MESA
80% of high school graduates complete four or more years of math	50% of high school graduates complete four or more years of math
Mean Math SAT scores are 465	Mean Math SAT scores are 397
Mean Verbal SAT scores are 395	Mean Verbal SAT scores are 362
87% of high school graduates enroll immediately in California colleges and universities	61% of high school graduates enroll immediately in California colleges and universities
78% of high school graduates attending California colleges are enrolled in four-year universities	35% of high school graduates attending California colleges are enrolled in four-year universities
36% of high school graduates enroll immediately at University of California campuses	8% of high school graduates enroll immediately at University of California campuses
Students' overall high school grade point average is 3.1	Students' overall high school grade point average is 2.4
Two-thirds pursue math-based majors in college	One-quarter pursue math-based majors in college
90% persistence rate at the university level	40% persistence rate at the university level

Source: 1984 Annual Report, Mathematics, Engineering and Science Achievement

■ Who initiates precollege minority engineering programs?

You. You can be a professional, you can be a layman. You can be an educator, an administrator, an employer of engineers—or none of the above. Your credentials lie not in your title but in your willingness to "deliberately intervene in the process of change and attempt to help organize the efforts of action systems to influence some community condition or policy."[9]

Whoever you are, you are energetic, enthusiastic, and deeply committed to the two imperatives behind the Minority Engineering Education Effort:

- the need to equip the nation quantitatively and qualitatively to meet its growing demand for scientific and technical manpower; and
- the need to advance equal opportunities for the nation's underrepresented minority population.

So far, existing precollege minority engineering programs owe their success to the people and groups closest to the problem, as identified in Figure 1:4.

Undoubtedly, most future precollege minority engineering programs will be launched and supported by people from these groups. As the accomplishments of the Minority Engineering Education Effort become known, a growing number of people like you are certain to recognize the merits of this approach and take on the responsibility of launching programs in their own communities. We anticipate that once you set up a program in one school, it will spread rapidly to many others in the school system.

Let us give you the benefit of years of work in the field. What follows are guidelines to get you started. They are not definitive, how-to instructions for you to follow step by step. They are suggestions based on the experience of existing programs and the expertise of NACME's staff that can be adapted to suit the needs of your community. They come with our encouragement as well as our gratitude. Good luck.

Figure 1:4

■ Supporters of Precollege Minority Engineering Programs

College/University Personnel
- Engineering college deans
- Minority affairs and admissions personnel
- Administrators
- Faculty members

Employers of Engineers
- Business/industry executives
- Business/industry human resources personnel
- Engineers and other employees
- Government agencies

Public School Personnel
- Teachers
- Guidance counselors
- Administrators

Minority Organizations

Community/Civic Organizations

Foundations

Professional Engineering Societies

2

Chapter Two: Assessing the Needs of Your Community

Successful precollege minority engineering programs share seven common characteristics according to *Promoting Success Through Collaborative Ventures in Precollege Science and Mathematics*[10], a manual on the evolution of 19 effective intervention programs. Among them are two traits that depend heavily on the nature of the support that comes from the community:

- successful programs are grassroots efforts initiated by people who have a personal or professional stake in improving education at the local level; and
- they are collaborations of local businesses, community organizations, higher education institutions, and public school systems providing expertise and resources to participant schools to supplement what is already available.

Before you launch a precollege minority engineering program, you must determine if the need is real. Your first step then is to document the need for such a program in your community. Your second step is to evaluate the community's potential for filling that need. These processes are generally termed needs assessment and system analysis.

The information you gather during this phase will serve as the foundation for your program. On this foundation you'll build the program's goals and design a strategic plan to achieve them.

A note of caution: when gathering data, formulating analyses, and carrying out actions in your community during the predevelopment stage, be sensitive to the people you approach for information. People connected with institutions, businesses or organizations initially may be leery of your inquiries. Negative reactions to you and suspicions of hidden agendas may critically hinder your progress.

Never give the impression you are gathering information to criticize the institutions you are researching. Conduct your investigations openly. Limit your inquiries to documenting local need for the supplemental educational activities of a precollege minority engineering program.

■ How do I assess the needs of my community?

Now is the time for you and others participating in this endeavor to begin dividing up the work. Ideally, a team of three allows one person to evaluate the educational arena, one to work on the business environment, and one to assess community organizations.

STEP 1: Assess the educational/environmental need.

Begin your community needs assessment by looking at the composition of the target area's student population. There are three areas to investigate: socio-economic characteristics, geographic distribution, and academic achievement. Figure 2:1 outlines the information you'll need.

Figure 2:1

■ Community Needs Assessment

Socio-economic Factors

Student ethnicity

Family income levels

Parents' educational levels

Geographic Distribution

Locations of the various schools by type

Feeding patterns within system

Presence/absence of magnet or special emphasis schools

Academic Profile

Academic preparedness—the sequential progress (building blocks) toward a particular educational goal—the presence/absence of a "tracking system" and its placement criteria—the demographics of various curriculum categories

Academic achievement—measures of cognitive skills/proficiencies and their ethnic breakdowns

Post-secondary educational enrollments by ethnic groups

The primary source for this data is your local public school system. Obtaining the data should not be a problem either for insiders or outsiders. It is standard procedure for school systems to gather statistics and other information about their students. By law, they are required to make this information available to the public.

For data that pertains to the school system as a whole, as well as to the individual schools, go first to the office of the school superintendent; for additional information about individual schools, go to the principal's office of that particular school. Look for the most current data available.

Socio-economic information relating to family income and parents' educational levels may not be available through the school system. If not, try census data from the U.S. Census Bureau, the state or local government census office, or the local planning commission. Appendix D gives you examples of the kind of data to be collected and sample formats for tabulating the results.

To gain the cooperation of the superintendent's office and the local school principals, submit a formal written request to the superintendent, explaining what kind of information you want, why, and how it will be used. You'll be surprised at how successfully a letter allays suspicions and facilitates the data collection process.

The letter should:

- introduce you; outsiders may want to enclose resumes to present their experience and qualifications
- state the purpose of your research: data will be used to document need and to gain community support for a precollege minority engineering program
- state that you will keep the superintendent apprised of future developments as your work progresses
- state that you will subsequently invite the superintendent to discuss the school system's possible role in the program.

Accompany your letter with background materials that present a clear and concise picture of the Minority Engineering Education Effort. Be familiar with the materials you send so that you are prepared to discuss them if necessary. We suggest you include such materials as the article "The Minority Engineering Effort," in the January/February 1986 edition of the magazine, *The Black Collegian* and a copy of *Promoting Success*. You may also want to contact NACME for an information packet that introduces the history and status of the effort.

A list of resources for this and sequential planning is presented in Appendix B.

The superintendent's office probably does not have the staff to tabulate the information you request, so offer beforehand or go to the office prepared to look through master records yourself and extrapolate the data you need. You may find that all the student information you want is in the superintendent's office and you won't have to go to the individual schools.

■ **How do I assess the potential support of my community?**

You want to identify institutions, organizations, businesses or school personnel that will support you in developing and implementing a minority precollege engineering program. What you're looking for are organizations that will play two distinct roles in this process:

Collaborators—those organizations that will take an active part in establishing the program, managing it and maintaining it on an ongoing basis.

Supporters—those organizations that will provide resources without being involved with program development and management.

STEP 2: Assess your local school system.

Your next step is to assess the school system as a potential collaborator in setting up a precollege minority engineering program.

You want to know:

- What is the school system's philosophy toward differentiated programming for minority students?
- What is the school system's philosophy toward joint student programming with community organizations?
- What type of special minority programs already exist within or in collaboration with the school system?
- What are the strengths and weaknesses of existing special minority programs?
- What supports (financial and physical) does the school system provide for its own or collaborative special minority programs?

Look for the answers to these questions in school policy statements or documents, reports and school activities. If you don't find the answers there, talk to key school personnel. In addition to the superintendent, those who might play important roles in making the decision to participate in the proposed program include assistant superintendents, the coordinators of math and science education, and the secondary schools coordinator.

It may be that the student demographics of your target area point clearly to one particular high school and its feeder schools as the best starting point for implementing your program. In this case, talk to the principals and heads of the math and science departments of these schools as well.

Sound out these people on their attitudes, interests, and motivations in the area of special minority education. If there's going to be any strong opposition to your effort, it's important to be aware of it ahead of time so that you can marshal your forces and plan a strategy to minimize or forestall resistance before the final decision-making stage.

It helps to know the politics of your local school system. Find out who holds the power and how decisions are made. The superintendent may be a strong leader within a regimented system or merely a figurehead with functional powers residing outside his or her office. The mayor, county executive, the president of the board of education or a group of board members, an assistant superintendent, a school principal or someone entirely outside official school governance may be the real "powers that be" in the school system's decision-making process.

To find out who will make the decision about your proposal, attend school board meetings that are open to the public and keep abreast of local educational issues through your local media. Ask discreet questions of any insiders you or your associates know to learn the predisposition of the school system's decision makers toward your effort, and solicit their suggestions for ways to convince the school leadership to support you. The insights you gain from these conversations will aid you greatly in formulating strategies to obtain support for your work.

STEP 3: Assess the potential support of the business community.

It is in the interest of your local business community to support a precollege minority engineering program. Why? Because many industries and utilities in the community employ a significant number of engineers in a variety of research, production and management capacities. Several service-oriented businesses also hire engineers as managers and for other positions. In addition, large numbers of engineers are employed by federal, state, and local government agencies. All of these organizations are potential supporters of a community initiative to increase the number of local minority students graduating from colleges with engineering degrees.

To assess the potential support of your area's business community, you need to compile a

directory of local companies. Go to the Chamber of Commerce, industrial and business associations, and the planning board within the local governing body to get this information. While you're there, get as much data as you can about the economic conditions in your area. This information will enable you to formulate a comprehensive picture of your target environment and help you in your dealings with representatives from the community's businesses.

You want to know:

- Who are the major employers in your area?
- What are the characteristics of the area's work force in terms of skill categories?
- How stable are the various segments of the work force?
- What are the long-term projections for the area's economic growth, employment needs, and financial performance of major employers?

When you have compiled a complete directory of businesses in your community, divide the information into two lists. On your first list, your primary list, put the names of all those organizations that have inherent interests in developing a large pool of qualified engineers for the future. We suggest that this primary list include businesses such as:

- subsidiaries, plants and other facilities of the nation's major corporations
- pharmaceutical and chemical companies and laboratories
- heavy machinery production industries
- engineering and construction firms
- utilities (electric, gas and water companies) servicing the local area
- government research and military installations
- public works departments
- transportation companies

Because of the nature of their operations, these businesses could:

- assist you with program development
- take an active role in program management
- take an active role in the program's student activities
- provide the program with material and financial support

On your second list, put the names of all those businesses that provide financial and other kinds of support to various local community projects. This list can be compiled from the annual reports of the local United Way and similar organizations.

List each company or organization with its name, address, and contact person. The contact person is usually the director of a company's community affairs department or public relations office. Include your contact person's job title and office telephone number. If a firm does not have a community affairs department, call the public relations office to find out who handles such matters.

STEP 4: Assess the potential support of your local community organizations.

The minority organizations in your community are excellent resources when developing and implementing a minority precollege engineering program. These are usually nonprofit groups and probably will not be able to assist you financially, but they can provide invaluable human resources and physical facilities, as well as crucial access to minority students.

If a directory of such organizations is not available, develop your own list by researching the annual reports of the local United Way and similar organizations. Check the yellow pages of your telephone directory under Associations, Fraternal Organizations, and Social Service Organizations for local chapters of national minority organizations such as ASPIRA, the League of United Latin American Citizens (LULAC), the NAACP (National Association for the Advancement of Colored People), and the National Urban League. To this list you can add service-oriented churches, fraternities and sororities.

A second list of potential community group collaborators would consist of the local Chamber of Commerce, business and industrial associations, local branches of professional engineering societies, local foundations and United Way-type organizations, voluntary associations and service clubs like Rotary, Kiwanis, and Lions. If not financial support, the organizations on this list certainly could provide human and physical resources.

The third list would be made up of post-secondary institutions and educational resources such as museums, libraries, publishers of educational materials and student pre-professional engineering organizations within colleges of engineering. In addition to consulting with you during pre-development and development activities, representatives of these institutions could provide valuable services and physical resources to students during the implementation of the program's activities.

An enormous source of support for a precollege minority engineering program is any college or university in your area that has a school of

engineering. Look for an institution within, at best, a 15-mile radius of your community. While you may have to go farther afield, experience has demonstrated that it's difficult to depend on consistent collaboration from an institution more than 50 miles away.

Before you make contact with university personnel, find out if the institution is already participating in the Minority Engineering Education Effort. As many as one quarter of the nation's 286 universities with accredited engineering schools are involved in some kind of minority engineering effort activities. Many of them have instituted minority engineering programs at the college level, and several are involved in precollege programs as well. You can get this information by consulting NACME or the Engineering Manpower Commission (EMC) of the American Association of Engineering Societies which annually publishes data on engineering and technology enrollments with ethnic, gender and other breakdowns.

NACME's biannual publications, *Students' Guide to Engineering Schools* and *MEPs/USA, The Directory of Precollege and University Minority Engineering Programs* can also give you some indication of your local university's commitment to increasing the number of minority students graduating with engineering degrees.

The university's course catalogue is a good source for names of professors to contact and the kinds of curriculum activities that might be available for the program development stage. Local colleges or universities might also be a source of collaboration or support through departments other than engineering, such as the school of education, the school of human development and outreach programs.

STEP 5: Launch your campaign for community support with the school board's endorsement, if possible.

Once you've assessed the needs of your community, and the potential support available for a precollege minority engineering program, you're ready to launch your solicitation campaign.

Before going out to the community at large, however, it's important to know how much support you can depend on from the school system. Now is the time to send a letter to the school superintendent, thanking her for her cooperation. Enclose copies of the data you've tabulated and any other information you've gathered on the school system.

If the superintendent has been cooperative and seems amenable to the proposed program, ask for her assistance in your solicitation campaign. A letter of support from the superintendent or an endorsement from the board of education would undoubtedly have a positive impact on potential collaborators. Give her a copy of your five lists of possible supporters, and ask her advice about the best way to proceed.

STEP 6: Prepare a presentation to introduce the proposed program to the community.

The next task is to organize a presentation to introduce your proposal for a precollege minority engineering program to the community. You and the school superintendent can invite members of the school board, the dean and faculty from the university's school of engineering, representatives from all potential endorsing groups on your lists, as well as local engineering societies and important community leaders.

Or request the opportunity to make your presentation to the school board, the Chamber of Commerce or an influential business or industrial organization. Endorsements from any of these groups would launch your solicitation campaign with a bang.

Prepare your presentation carefully. Make it short and concise, focusing on the following points:

- the national Minority Engineering Education Effort
- your perceptions of the local need for a precollege minority program
- the superintendent's and school board's support
- your plans to bring together business and community collaborators to design the program, manage it and carry out its activities
- the gains that the community can expect to realize from a successful program

Rehearse your presentation so that you're familiar with it and you feel comfortable standing before an audience delivering it. Think of the ten hardest questions you hope you don't get, and prepare answers to them. Make copies of background materials about precollege minority engineering programs to distribute to your guests.

After your presentation, ask for questions from the audience. If you get a question you can't answer, tell the questioner you will get back to him later with the answer. Don't expect an endorsement for your program right then and there. But do inquire as to when you can expect to have a decision. Now is the perfect time to ask for volunteers to work on your support team.

Chapter Three: Assembling Your Support Team

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Phase II of the predevelopment stage is converting potential supporters and collaborators into committed active participants in the precollege minority engineering effort. The most effective strategy for accomplishing this is to convince community businesses and organizations that the program you propose is a worthwhile thing to do, and that it's to their benefit to participate.

Once you've piqued their interest, the next step is to create working involvement in developing the program. This will lead your corps of volunteers to "buy into" the program and "make it their own."

Take care to be tactful when approaching potential supporters. Even if you encounter opposition, avoid saying or doing anything that might alienate people or lead to negative perceptions of you and the program. Once a potential supporter, always a potential supporter. An organization may choose initially not to participate, but could be moved to do so one year or even five years down the road. Leave everyone you speak with feeling good about what you hope to do.

■ Who should be on the support team and how are they best recruited?

Each of the contact people and organizations on the lists you've assembled should be viewed as a likely participant in the work that's yet to come.

STEP 1: Obtain the support and participation of local school officials.

You may have already laid the foundation for collaboration with the local school system through your contacts with the superintendent. His responses to your request for data and your follow-up progress report should give you an idea of whether or not he is interested in supporting a precollege minority engineering program.

If the superintendent has indicated support for such a program, set up a meeting to discuss the role the school system could play in its development and implementation. Explain that you want to bring along someone with experience in

precollege minority engineering programs to make a brief presentation about programs that have collaborated successfully with their local school systems. Suggest that the superintendent invite other key school administrators and members of the board of education to this meeting.

To fill the role of resource person, try to get a representative from a nearby public school system that is already participating in a precollege engineering program, or a precollege program administrator who is closely associated with a school system. In the event you cannot find a resource person locally, you may call NACME for technical assistance.

Anytime you use a resource person for a public presentation, be sure to meet with her prior to the presentation. Before she addresses your constituency, you want to inform her about the particular characteristics of your target area which may be different from her own. Take the time to acquaint yourself with her presentation so that you're certain her information is relevant and constructive for your community's needs, and be prepared to answer questions when they arise.

When the meeting with the superintendent takes place, your goal is not to specify exactly how the proposed program would provide supplemental educational activities for minority students, but to outline several possibilities.

At this meeting, you want to achieve three important objectives:

- an acknowledgement of the need for a precollege minority engineering program, and its potential benefits for the targeted students and the school system in general
- a commitment by the school system's leadership to participate in developing the program
- a commitment by the school system's leadership to back your attempts to obtain community support for the proposed program

On the other hand, if the superintendent does not appear to be amenable to a minority engineering program, perhaps his response to your initial letter requesting student data indicates why. Two possible reasons come to mind. First, the superintendent may object to the school system's being affiliated with a program providing services for one particular segment of the student population to the exclusion of all others. Second, he might be concerned about the costs of implementing such a program.

In response to his first objection, propose that you and your colleagues work with him to implement math and science enrichment activities for *all* secondary students, in or out of the program. Improving the quality of elementary and secondary education, in general, and mathematics, science and technology education, in particular, are national concerns. Point out that several mechanisms have been developed to augment the educational and motivational services provided by public schools. (See Appendix B for a list of organizations and the kinds of resources they provide.)

Given the unique position of underrepresented minorities in this society, however, stress that you don't want to compromise the need for special and differentiated activities in math and science for minority students. Emphasize the pedagogical impact that enrichment programs in these areas could have on participating students, teachers and other school personnel, the school system and the local community as a whole.

In response to the second objection—cost—advise the superintendent that one of the common features of successful precollege minority engineering programs is that expenses are relatively low. Explain that while it is desirable, it is not a prerequisite that the public school system contributes financially to the operations of the program in order to participate.

If the superintendent is disinclined toward the idea of a precollege minority engineering program for other reasons, either unclear or unstated, enlist the aid of an influential school decision-maker to help persuade the superintendent to give you and your colleagues at least a hearing on the proposed program. Because of the political complexities involved in such a situation, you may want to seek the advice of a consultant or resource person in techniques for courting principal decision-makers.

STEP 2: Obtain business and community support.

You may have met some of the business leaders in your community during the presentations you made. Now is the time to follow up with a solicitiation letter to them and to others on your lists. The letters should be designed to do two things: generate interest in your proposed program and solicit support or collaboration in developing and implementing it.

To generate interest in the program, introduce yourself and your colleagues in this endeavor. If you already have firm commitments from people in

the business community, have them cosign the letter. Such early endorsements can give your program instant credibility in business circles. Express your ideas and include the information you've gathered about the need for a precollege minority engineering program in your community.

Outline your proposal for the program and illustrate it with background materials that present a clear and concise picture of the Minority Engineering Education Effort. Enclose copies of the letters of endorsement you've already received.

Point out that you are approaching this company because of its expertise in the engineering field and its invaluable source of trained engineers, who could assist with the design of the program and provide role models and mentors for minority students. Include a few examples of companies with similar enterprises that have participated in precollege minority engineering programs.

While you don't want to appear unduly flattering, acknowledge your awareness of the firm's fine reputation in the community for supporting such projects. Mention that whatever human, physical, and financial support the company gives you will be publicized on continuing basis.

STEP 3: Plan a kick-off meeting.

In your solicitation letter, invite each company to send a representative to a two-hour kick-off meeting scheduled a month or so in the future. Explain that the purpose of the meeting is to present your proposal for a precollege minority engineering program in more detail, and to outline the kinds of practical roles business and community organizations can play in designing and implementing it. Attach a tentative agenda.

Your guest list for this meeting should include all the companies on your primary and secondary lists of potential business collaborators, as well as all the organizations on your three lists of potential community supporters.

Allow your guests at least two weeks to respond to the invitation. At the end of that time, divide up the guest list among your associates and telephone each one of the organizations you haven't yet heard from.

During your conversations with the groups, stress the importance of the kick-off meeting for establishing the proposed program, and outline the specific contribution that their company or organization could make to such a program.

To organizations that decline your invitation, express your regret and tell them you will keep them apprised of the program's progress through minutes and announcements.

■ **How do I organize the kick-off meeting?**

How you stage the kick-off meeting itself is very important. While it is not quite a make-it-or-break-it situation, this meeting is a crucial step in developing your precollege minority engineering program. You are attempting to establish new links between existing organizations that will lead to the creation of a new organization or association. In doing so, the style of the meeting you plan is as crucial to achieving your objective as the content of your presentation.

Remember: the goal of the meeting is to impress on your guests the gravity of the need for the proposed program and to sweep them up in your enthusiasm for successfully achieving its goals. So stage the meeting to grab your guests' attention, put them at ease, and elicit their active participation. The seating arrangement and group size can help you do this. Create a warm environment so that attendees can see and respond to each other's enthusiasm and interest. We suggest that the group not exceed thirty.

Leading this meeting or any meeting in this endeavor requires you to be knowledgeable of organization theory and group dynamics. A full discussion of these subjects is beyond the scope of this handbook. However, we would like to outline several pertinent principles:

Principle of Participatory Leadership

Try to instill a sense of belonging among the people you hope will play an active role in the governance, design and implementation of the program.

Principle of Group Attraction

The more attractive you and your colleagues and the proposed program are to potential supporters, the greater influence you'll have on them.

Principle of Felt Need

You can build strong incentives for designing and implementing your program by creating a shared perception of the need for such a program in your community.

Principle of Feedback

Share information about the need for a precollege minority engineering program, the planning and implementation processes, and the program's anticipated achievements with everyone who is interested in participating in the initiative.

After you've completed the preliminary planning for the kick-off meeting, ask your resource people and the organizations that have already endorsed your effort for their help in the final planning stages. One of the organizations might be able to provide the space for the meeting and audiovisual equipment if required. Another could provide refreshments. The aid and technical assistance these groups contribute to the meeting will undoubtedly make a positive impression on your potential supporters.

■ **What should the agenda look like?**

Kick-off Meeting
Suggested Agenda and Discussions

Registration and Refreshments (twenty minutes)

Set a tone for the meeting that is conducive to achieving your goal of obtaining support for the program. Greet your guests personally at the door with an information packet that provides complete details about the program and your efforts to date. The packet should contain:

- a name tag with the guest's name, job title and organization
- a copy of the agenda
- a list of expected participants and their affiliations
- background materials
- statistical and other information about your local school system
- outlines of program models
- outlines of organizational committee assignments
- notepaper and pen or pencil

A comprehensive packet like this impresses your guests with your professionalism and your sense of organization. At the same time you want to create an atmosphere of camaraderie. Serving refreshments gives you and your colleagues the opportunity to introduce yourselves to your guests, to introduce your guests to each other, and to talk informally.

Welcome and Introductions (five minutes)

At the designated time, the person selected as the moderator calls the meeting to order. He welcomes the guests and thanks them for attending this very important meeting. Then introduce yourselves—the initiators. Explain briefly how and why you came together to launch this effort, and describe the actions you've taken up to this point.

Endorsements (three minutes each)

Begin by introducing the businesses or community groups that have already endorsed you. Call on a representative of each of the endorsing organizations to explain succinctly to the group why the endorsement was made. The support of respected people and organizations is extremely persuasive in motivating others to back your cause.

Presentation A—National Perspective: The Minority Engineering Education Effort (ten minutes)

A resource person discusses the history and activities of the national minorities in engineering effort. This presentation should stress the need for such programs from a national perspective. At the end of the presentation, the moderator asks for questions from the audience.

Presentation B—Local Perspective: The Need for a Local Precollege Program (ten minutes)

We suggest that one of the other organizers make this presentation with the assistance of a school administrator. Present the information you have gathered on the demographics of the local student population. Outline the factors you perceive to constitute the need for the supplemental activities of a precollege minority engineering program in your community. Discuss the benefits of such a program for the students, the school system, and the community as a whole. Follow the presentation with a question and answer period.

Presentation C—Program Models (fifteen minutes)

Another organizer, with the help of a resource person, presents some examples of effective precollege minority engineering programs (see Appendix E) that could be used as models for the development of your local program. Questions and answers may follow this discussion or be delayed until you come to the organizational development segment of the meeting, during which the program models will be discussed in greater detail.

Group Discussions: Organizational Development (forty-five minutes)

This is the participatory segment of the agenda. The moderator presents the next phase of the program's development—the organization of three planning committees. These committees and the decisions they must make are:

Governance/Administration

How will the program be managed and administered? Should the program be incorporated as an entity unto itself or should it function as a unit of another organization?

Program Design

The what, when, where, why, and how of the student activities that will constitute the program.

Resource Development

How will the program procure and sustain the financial, physical, and human resources to implement the program as planned?

At this time, divide the audience into three groups to discuss each of these three committee assignments. Allow your guests to choose which group to join, but encourage an equitable distribution.

The tasks of the three committees are obviously dependent upon each other and overlap. Accordingly, each of the organizers should lead one discussion group, and he will head that committee when it is officially convened. As committee heads, you and your colleagues will be able to direct and coordinate the program's planning.

In leading discussion groups, be prepared to present more detailed information from program models relevant to the topic. Be careful not to dominate the discussion. Remember, your objective here is to stimulate the interest of your guests by giving them the opportunity to express their thoughts and ideas. Don't be particularly concerned with the substance of their contributions. Simply be receptive to their participation.

Be diplomatic, yet forceful and positive if a guest's comment has a negative influence on the discussion.

When the time allotted for this item is up, you may want to assign a representative from each group to summarize the committee's conclusions for the audience as a whole.

Notice of Participation (two to five minutes)

Those organizations that have made the decision to participate in the precollege minority engineering program at this time may choose which planning committees they want to join. Urge the organizations that have not yet made a decision to do so within the next two weeks and to notify you so that the next phase of planning—the formal committee work—can begin.

Adjournment (three minutes)

Thank your guests for coming and participating in the meeting, thank them for the encouragement they've given you to proceed. Summarize briefly the results of the meeting. Announce that you and your colleagues, your resource people and endorsing organizations are available for more questions or concerns when the meeting is adjourned, or by telephone in the days to come, should questions arise when representatives report to their organizations.

STEP 4: Look for an administrator.

During the transition from the predevelopment stage to development, the next step is to look for an administrator to manage the program, preferably an experienced educator who shares your commitment to the need for such a program. In addition to various managerial and communication skills, the administrator should exhibit the personal attributes required to be an effective leader in this type of intervention. These include self-motivation and commitment.

The adminstrator should be a dynamic if not charismatic leader capable of motivating others to participate in the endeavor. She should possess the professional skills and poise to work effectively with the wide spectrum of people from various ethnic and socio-economic backgrounds who are or will become associated with the program. This person may be one of you who have initiated this effort, someone in the community who you know shares your commitment to the proposed program, or an executive on loan from a participating company. If you are unable to locate such a person, perhaps the school superintendent knows an administrator or a teacher in the school system who fits this demanding bill. You can also consider recent retirees from academe or industry, or ask for referrals from your local college or university, from your other endorsing organizations, or from similar programs nearby.

It is important for the program administrator to become involved early on in the development stage of the initiative so that she can assist you and your colleagues and serve as the spearhead in building your program.

4

Chapter Four: Structuring the Organization

With a team of collaborators and supporters firmly committed to your initiative, it's time to embark upon the "nuts and bolts" of the developmental phase. By this time you'll know the contribution each of the participants is prepared to make. The degree of their participation will determine to a large extent the scope of your program's organization and design.

Don't be discouraged if your team isn't as large as you expected. Regardless of its initial impact, your organization has the potential for growth—to evolve continually toward your goal. Even small-scale interventions, if effectively implemented, are of tremendous benefit to the students serviced. Also, don't underestimate what you've already accomplished. You've brought together a group of organizations and individuals and primed them to function as an association to establish what has now become their initiative as well.

You have already laid the foundation for organizational and program development. The three committees set up at the kick-off meeting now take on formal roles in the program planning process.

The Governance/Administration Committee must complete its work before the other committees can swing into action. The structures, statutes and policies decided upon by this group and subsequently accepted, rejected or amended by the instituting body will become binding guidelines for the planning of both Program Design and Resource Development Committees.

It is the responsibility of the Governance/Administration Committee to:

- name the organization
- produce a statement of purpose or mission
- delineate a program philosophy
- decide upon the organization's governance
- write its bylaws
- determine the program's administrative structure, and
- develop organizational and program policies

■ Define the organization and its mission

The name of your organization should reflect the program's geographic location as well as its reason for being. As a clearly defined purpose is essential to any organization's success, you should also draft a mission statement that describes what the organization hopes to achieve. Use terms that are broad enough to encompass all the program's goals and objectives while avoiding ambiguity. A good mission statement might use such wording as:

> *The mission of the Crawfordville Area Program for Minorities in Engineering, Inc. (CAPME) is to increase the number of Black, Mexican American, Puerto Rican and American Indian students from the Crawfordville area who graduate from high school with sufficient interest and adequate academic preparation to pursue successfully the study of engineering or some other science/math-based career at the post-secondary level.*

■ Establish a program philosophy

At this point, it is important for the committee members and the program developers as well to understand that, when setting up a precollege minority engineering program, you are at the same time creating a cultural entity or social system. Social systems influence the lives of every member of modern society, and each system plays a role in the process called socialization. It is through the socialization process that society transfers its knowledge, values and behavioral patterns to its individual members.

While most social systems evolve over time in a haphazard manner, shaped and maintained primarily by tradition, a program like the one we're proposing is a planned intervention designed to impart specific norms, values and expectations. In short, precollege minority engineering programs intend to socialize their target audiences.

Program developers don't have to be experts in the socialization process, but they should be aware of its importance in creating an ethos or social philosophy to serve as the foundation for program activities.

A program's philosophy is an elaboration of its mission. It is a compelling statement of the fundamental values and attitudes that act as guiding principles for an organization's development. It guides you in setting the program's goals and objectives as well as its operational procedures, and directs the actions of those responsible for program implementation.

In formulating the philosophy of a program designed to advance the academic performance of minority students, don't fall into the compensatory/remedial education trap. Most such programs are based on the theory of deficit learning. This theory posits that underrepresented minorities begin their schooling and continue all through their school years handicapped by cultural deficits that are the consequence of family and socio-economic conditions. Therefore, the goal of most compensatory/remediation programs is to alleviate the "cultural deprivation of disadvantaged minority students."

At the opposite educational pole, successful precollege minority engineering programs have enrichment as their focus. The philosophy of such programs sets forth a value system that includes:

- an unwavering belief in the capabilities of the targeted students to learn all that is required in their pursuit of an engineering or other scientific or technical career.
- a recognition of and sensitivity to cultural differences, particularly learning styles, and an acknowledgment of the need to institute activities that build upon the strengths and positive characteristics of cultural diversity.
- a recognition and celebration of the intrinsic worth and uniqueness of the individual, including the realization that a cultural subgroup is not a monolithic entity and, accordingly, that intervention strategies designed to enrich the academic and motivational preparation of its clientele should not be uniformly applied.

Together, the attributes described above and the program characteristics that are discussed under "What is a precollege minority engineering program?" in Chapter One and "What services are offered by successful precollege preengineering programs?" in Chapter Five form the basis for a philosophy that creates maximum support for minority students and is responsive to their individual needs for educational and motivational enrichment.

■ **How are precollege programs most effectively governed?**

The Governance/Administration Committee faces an important decision regarding the basic structure of the newly formed precollege program—whether to incorporate as an independent, nonprofit, educational organization or to become a unit of a larger body. If the level of local participation that you've drawn is limited, with most of your support coming from one collaborating organization, we suggest that you create your program as a unit of that institution. A public school system, college or university, business association or engineering society are all possible parent organizations. However, if participation and financial commitment are clearly adequate, give serious thought to incorporating your program as an independent, nonprofit, educational organization.

Before proceeding in either direction, there are several important questions to consider:

- Will it be easier to secure funds and grants as an independent organization or as a unit of one of the collaborating institutions?
- Will you be able to procure sufficient financial resources from a varied group of donors to function independently or will you depend, during the early stages of program implementation, on small financial and in-kind contributions from a few collaborating and supporting institutions?
- Do you want to form and function under a board of directors as incorporation laws require?
- Will you be able to enlist the active participation of enough influential people (organizational heads and/or high level managers of the collaborating institutions) to constitute a "power" board of directors, or will it be wiser to operate with an advisory board until you secure additional commitments?
- Is it more advantageous to institute a "power" board or an "active" board of directors consisting of middle level managers and community leaders who can assume an active role in the management of program implementation?
- Will it be easier for the local public school system to develop program partnership arrangements with an independent organization or with a unit of an existing institution?

Remember, even if you choose to operate initially as a unit of a collaborating organization, you can retain the right to move to independent status at a later date. This provision should be stated in your bylaws. For example: "The (organizational name) has the option to withdraw the program from the parent organization and set up an independent, nonprofit organization at some future date."

As the committee considers this crucial question, keep in mind that independent status allows for greater operational freedom and flexibility. However, in addition to the financial constraints impacting your decision, there are other pros and cons specific to each community that the committee must evaluate.

Whatever you decide, the organization should certainly obtain not-for-profit status. Donations of money and in-kind contributions are more attractive to donors and more readily procured when they are tax deductible. This status also affords an organization lower postal rates, sales tax exemption, and other advantages.

Several governing frameworks are appropriate for alliances that institute intervention programs. Small-scale interventions initiated as a unit of a collaborator might begin with an advisory board or governing committee. Larger scaled efforts might institute various types of boards of directors. Such boards can be self-perpetuating or elected by the organizational membership. Many boards also have a provision whereby the board members can designate representatives to be responsible for some of the tasks required.

The role of a board of directors or other governing body is to manage and direct the activities of the organization. It is responsible for:

- Planning: determining what the organization is, what it proposes to achieve, and what the best route is toward accomplishing its mission.
- Organizing: dividing work, allocating resources and delegating authority and responsibility for implementing organizational plans.
- Controlling: developing and imposing mechanisms that ensure the effective and efficient use of resources, and evaluating the progress made toward planned goals and objectives.

The Nonprofit Organization Handbook, edited by Tracy D. Connors, contains thorough discussions on the role of a board of directors and other organizational development and implementation matters.

In reviewing the governing frameworks of existing, successful precollege minority engineering programs, we found that many have structured themselves as membership associations. Programs with organizational members include the

Detroit Area Pre-College Engineering Program, Inc. (DAPCEP), the Buffalo Area Engineering Awareness for Minorities, Inc. (BEAM) and the Philadelphia Regional Introduction for Minorities to Engineering Inc. (PRIME). At the same time, other equally effective programs, including MESA and SECME—cited for their successes in Chapter One—do not have organizational members. These programs are also incorporated as non-profit, educational organizations and have been able to secure the support of businesses, institutions and other organizations on a continuing basis.

An advantage for developing programs that create themselves as membership organizations is the base of support such a structure provides. This is especially important at the onset of program activities since it is difficult for organizations without track records to attract outside funding. Less concrete but equally sustaining advantages can evolve from the professional relationships that develop when people work together on collaborative ventures.

Within a membership organization, members include all collaborating organizations and affiliate organizations such as the program student council and parent advisory group. Some programs also allow for representation of supporting organizations, which might have their own category of membership. The appropriate number of representatives from each collaborating and supporting organization to the instituting association will depend upon the total number of participants and the membership classes you elect to institute. These decisions should be set forth clearly in your bylaws.

Bylaws, the set of internal rules by which an organization conducts its management, and Articles of Incorporation, an application for incorporation as an independent entity, are not as difficult to write as one might imagine. One of the committee members may be familiar with such documents. If not, excellent references and models are available. We suggest Howard L. Oleck's *Non-Profit Corporations, Organizations, and Associations*. For incorporation models, you can write to:

American Law Institute
American Bar Association
Committee on Continuing Professional Education
4025 Chestnut Street
Philadelphia, Pennsylvania 19104

Perhaps a lawyer employed by one of the collaborating organizations can review your bylaws before you present them to the instituting organization. Since incorporation requires familiarity with state laws, an attorney definitely should be involved in that process. Federal tax-exempt status can be acquired by completing Internal Revenue Service Form 1023, which contains filing instructions and requirements.

If you opt to establish a membership association, your bylaws should include provisions for:

- classes of membership with well-defined voting rights and termination procedures
- the membership, not the board of directors, to elect board members
- minimum annual dues for the various membership classes, including affiliated student and parent organizations, that are well defined in terms of resources—financial, physical and/or human—to be contributed annually to the program
- organizational heads of the program's student and parent organizations automatically to become members of the board during their terms in office
- members of the board of directors to be initially elected to one, two and three-year terms, thus allowing for both continuity and change
- the board of directors to meet at least quarterly
- an executive committee consisting of the officers of the board of directors and the standing committee chairpersons to meet at least once between board meetings
- all meetings to be conducted according to *Robert's Rules of Order* or some other parliamentary guide

In a membership association, the board does not have the power to enact fundamental changes in the purposes, directions or methods of the organization. This power is reserved for the membership and should be explicitly stated as such in the bylaws.

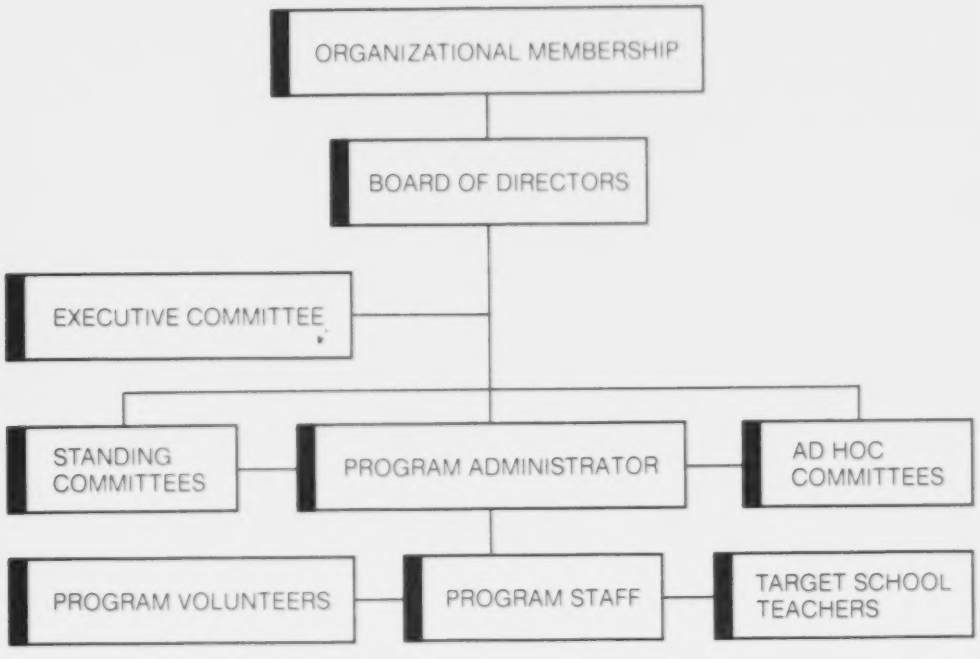
Figure 4-1 is an organizational chart that shows the working relationships in the membership model of program structure.

■ How are precollege programs funded?

The resources available to a local precollege minority engineering program are financial and in-kind contributions. Financial contributions include membership dues, grants, gifts, bequests and endowments. In-kind donations include human services, space, furnishings, utilities,

Figure 4.1

Organizational Chart



supplies, materials, publications, equipment, and services such as transportation, printing and computer time.

Your status as a legal entity, the governance and organizational structure you choose, and the policies you adopt regarding donations will determine to a large degree what sources of support are available to you. Geographic location may also have an impact on your ability to raise funds. Grant proposals and other requests made to national corporations and private foundations are often dependent upon the granting organization's presence in your community. As a general rule, contributions to local programs are most easily secured from groups with a local interest.

If your program is structured as a unit of a collaborating organization, you will not be able to receive direct financial support. Contributions will have to be channeled through the parent organization. Organizational policies will also determine whether or not the precollege program can receive public support.

We strongly recommend that, in making decisions regarding organizational structure, you avoid any measures that limit your access to support. Seek to establish policies that allow you maximum leeway in resource development.

Chapter Five: Getting Started

5

As soon as the Governance/Administration Committee has completed its work, convene a meeting of all the members of your alliance to formally launch your precollege minority engineering program. The first order of business is the approval of the organization's bylaws and, if applicable, the Articles of Incorporation. Mail these documents well in advance with the invitation to participate so that every member has a chance to become familiar with them.

After an opening discussion, you are ready to vote upon and finalize the instituting documents. If you are incorporating, the Articles must be filed with the state. State laws will dictate whether or not you may continue at this meeting with board elections. Extensive rewriting of the bylaws and/or Articles might also necessitate holding elections at a later date.

In conducting the elections, you may establish a nominating committee charged with developing a slate of candidates or you may open nominations to the entire membership. The best candidates for the positions of officers and members of the board of directors are those individuals who have made the greatest contribution to the organization up to this point. Before elections are held, emphasize that while the board fulfills trusteeship responsibilities, the success of the organization depends upon the collective efforts of the entire membership. Members of the organization not elected to the board should serve on one of the standing committees or any of the ad hoc committees that members feel should be established.

Among the first responsibilities of the installed board of directors is action on the recommendations of the Program Design and Resource Development Committees. The scope of the committees' planning activities will determine what services the program offers and how they are funded.

While it is not necessary that all members of the Program Design Committee be educators, the committee should rely heavily on educators' expertise when developing the program's student activities. Consult local school system administrators, junior and senior high school guidance

counselors and math and science teachers, and the faculty and professional staff from the collaborating college of engineering and other post-secondary institutions for their recommendations if such people are not significantly represented on the committee.

■ What services are offered by successful precollege pre-engineering programs?

Based on our experience in the field, NACME has identified eight enrichment components that together constitute a comprehensive precollege minority engineering program. Each is a combination of like activities that have a sustained impact directly upon the students' behavior. Like many complex systems, these eight components are mutually dependent, overlap to such a degree as to blur distinctiveness, and must function in coordination with each other to achieve optimum results. We advise the Program Design Committee to include as many components as possible initially, and to plan for the eventual incorporation of all others.

1. Counseling and Advising

The workloads of most public school counselors and teachers are usually so great that they do not have the time to provide the level of counseling services many students need to prepare for the demands of a college experience. Accordingly, effective intervention programs should provide student participants with supplemental counseling. An effective counseling and advising component consists of a number of subcomponents.

Career education and awareness activities should be developed to inform the students of employment opportunities in various engineering fields and other science/math-based careers. Students need to discover what engineers and other professionals in technical fields do when they're on the job, how they prepared for their careers, and what gratifications they receive from their work.

Guest speakers, field trips, printed materials and audiovisual presentations are all excellent means to stimulate student interest, academic performance, and career awareness. Increased motivation, too, often results from a greater sense of relevance. As students see more clearly the relationships between the academic skills they are asked to master and their career choices, they become motivated to study and work more diligently.

Another subcomponent of the advisory activities guides students through the proper sequence of academic courses in junior and senior high school. Some documenting mechanisms should be devised to ensure that program participants enroll in the appropriate courses. Attending college, particularly with the intention of majoring in engineering, requires the kind of long-range planning with which many minority students have had little or no experience. Thus, the counselors or others providing this service should be knowledgeable about high school courses and the performance levels required by various colleges and universities.

A personal growth and development subcomponent might be incorporated to increase self-esteem, self-awareness, and motivation to learn and achieve. It would be quite appropriate for this subcomponent to foster "in-group" dynamics among the students in the program. Peers are often the primary role models for student behavior. Carefully conceived and implemented activities can create a system that reinforces constructive behaviors, while eliminating behaviors that restrict academic and social advancement.

The counseling and advising component should also provide activities for high school juniors and seniors that are geared to the college exploration and application process. In particular, guidance and individualized assistance should be offered to seniors seeking admission to post-secondary institutions and those requiring financial aid. NACME's publications, *Students' Guide to Engineering Schools* and *Financial Aid Unscrambled*, are excellent printed tools for student workshops. Goal-setting and other personal growth skills can be effectively introduced within this framework.

Also worthwhile are a series of activities that foster leadership ability. The formation of student clubs at target schools or the development of a program student council advances "in-group" dynamics while furthering the students' sense of responsibility. Such involvement gives young people access to the decision-making process, expands their understanding of democratic government and the political process, and heightens their sense of control. Participating students learn that they can play a significant role in the forces that shape their lives. Student leaders, guided by an advisor, have the ability to plan and implement a variety of academic, cultural, social, and fund-raising activities. The experiential knowledge they gain can be enhanced by incorporating formal leadership development seminars and programs.

2. Parental Involvement

The family and home environment are widely identified as the most significant factors in children's academic achievement. Therefore, it's essential that your program involve the participants' parents or guardians. Beyond allowing their children to participate in the program, parents can provide invaluable assistance in implementing program activities and achieving program objectives.

Parents can systematically monitor their children's school attendance and academic performance, facilitate individual and small group study sessions, volunteer to arrange transportation for excursions, and serve as chaperones for program activities.

Families don't have to be middle class, either economically or educationally, to communicate values and exhibit behaviors that promote development of self-confidence and self-discipline in their children. Such values and behaviors include: a belief in upward mobility through education, praise for good behavior, achievement and delayed gratification, and supportive supervision of a child's activities both inside and outside the home.

Many parents, while sincerely wanting their children to be successful in school, lack the experience to help them. In minority communities, the problem is often compounded by parents' fatalistic attitudes about their own ability to make things happen or change. Sometimes, cultural values and traditions or personal outlooks have led parents to purposefully constrict the intellectual development of their children, require daughters to adhere strictly to traditional female roles, and allow spiritual beliefs to preclude the pursuit of a technical career.

These constricting forces can be mitigated by a formally organized Parent Advisory Organization, in which parents, program organizers, staff members and guest speakers can carefully direct parent attitudes, abilities and behaviors toward supportive guidance. In addition to fostering a collective spirit, a parent support group can assist the program with fund-raising activities and make the program more attractive to funding sources. As with student leaders, a representative of the parents' organization is an asset to your board of directors.

3. Role Modeling

The paucity of minority professionals in scientific/technological careers and the importance of effective role models in developing the motivation to pursue such careers were discussed in Chapter One. To be effective, your program must employ an assortment of ways and means to address this void. Although it is desirable, role models need not be members of the targeted minority groups. However, it is essential that they be genuinely concerned for the well-being of the individual students and the target group as a whole.

The activities of this component will create opportunities for students to observe engineers or scientists in work situations and to interact with them in a number of learning and social settings. The goal is to encourage students to perceive these role models as real people, possessing all the human attributes they see in themselves and people they know well.

When choosing role models for your program, it is imperative you stress that it's only through ongoing involvement, and not one-shot or infrequent encounters, that role models become decisive motivating factors in the lives of young people. Role models can provide services such as counseling students, tutoring, developing and supervising hands-on projects, presenting group demonstrations, leading tours of engineering facilities and other field trips, and monitoring students' academic progress.

If you're lucky enough to draw sufficient professional participation, consider a formal mentoring program. Selected students would "shadow" a professional engineer on the job and have the opportunity to ask questions in a one-on-one setting. Other structured role modeling activities include joint research projects and internships which are excellent possibilities during summer employment or exploration programs. In addition to enhancing the sense of relevance, role modeling activities contribute to students' self-realization and self-direction.

4. Student Achievement Recognition

Recognition of academic achievement is an effective motivational mechanism to promote learning. Various forms of reinforcement reward and consequently promote particular behaviors. Awards, certificates, trophies, honor rolls, awards banquets, media features and special excursions for honorees can all be positive reinforcers.

Different kinds of recognition work for different people. Realize that a positive reinforcement for one student may be practically meaningless for another. Some existing programs have even used

financial incentives to reward students for designated levels of achievement. They've found, however, that money is not totally effective as a motivational instrument for all students.

We suggest you use a variety of methods to reward achievement. Seek the students' opinions in deciding which forms of recognition to institute. Your student council can be very helpful here. Whatever you decide, it's important to be consistent in maintaining the levels of academic success that you choose to reward.

5. Student Projects, Fairs and Competitions

Many minority students have preconceived notions that they do not possess the aptitude for science or math-based careers. Others have been "turned off" to science and math by insensitive or inadequate teaching, or by the negative attitudes of their parents or peers.

Math and science projects are a particularly effective means to stimulate interest in these areas at the elementary and junior high school levels. In the high schools, working on projects for science fairs and competitions not only strengthens student involvement, it also advances learning.

Challenging math and science projects include puzzle-solving, games, construction, investigation, and research. Well-conceived projects call upon students to use their intelligence in new ways as they attack problems, explore a variety of solutions and reason independently and in groups. As students improve their problem-solving skills, they feel an increasing sense of competence which often results in positive motivation.

6. Summer Enrichment Programs

Enrichment programs conducted during the summer have the potential to make a tremendous impact on students. The services they provide are likely to be more extensive than those offered during the school year. Equally important, a summer program is an excellent opportunity to control the environmental factors that affect participating students.

Summer programs can introduce students to the math and science courses they will be taking in the upcoming academic year or they can offer courses not available to the students at their schools. Whatever the curriculum, summer programs should include instruction in communication and study skills in addition to math and science work. NACME's *Design for Excellence: How to Study Smartly* is commonly used to discuss and strengthen independent study skills.

We strongly recommend that summer programs and tutorial components provide students with extensive instruction in problem-solving. Exposure to methods of inquiry and higher-level thinking skills helps students understand concepts rather than merely memorize facts and figures. Reasoning skills combined with adequate study skills prepare students to plan and implement their own learning activities, independently of facilitators.

Six to eight weeks is an ideal length for a summer program. A program that lasts fewer than four weeks cannot realistically serve as an enrichment strategy. Short programs can be quite useful, however, as exploratory experiences for students who are already highly motivated achievers.

We've found that residential programs on college campuses are the most effective summer experiences. In such settings, intervention programs are better able to control the environmental impact on students. If you can't arrange a residential program, try to set up a commuting program in conjunction with a post-secondary institution. You might also arrange for a limited number of participants to enroll in summer programs such as Minority Introduction to Engineering (MITE) and Pre-Freshman Engineering Program (PREP) which are sponsored by a number of colleges and universities nationwide under the auspices of JETS, Inc. and the U.S. Department of Energy, respectively.

7. Teacher/Curriculum Improvement

Second only to the family as a critical element in the intellectual development of students is the quality of teaching—the attitudes, skills and behaviors teachers bring to the classroom and their application of teaching methods and instructional instruments. For your precollege minority engineering program to achieve the desired results, you must enhance the quality of teaching experienced by participating students within and outside program activities. Use the linkages you've developed with the public school system, business and community groups, and post-secondary institutions to assist teachers in performing their roles more effectively.

The competence of teachers within any given school system probably ranges across the spectrum. As in any other field, however, there's always room for improvement. Most teachers and

school administrators welcome opportunities to further their professional development.

Specialized in-service training, workshops and summer institutes are just a few of the proven means to build the quality of teachers' classroom instruction. Initially, you'll want to limit this training to math, science and English teachers from the program's target schools, but your community relations will benefit greatly if you eventually open it to all teachers.

In addition to instructional delivery skills, it's important that this component address teacher expectations. Many teachers, reflecting views held by the society in general, perceive underrepresented minority students to be less academically able than white and Asian students. Their lowered expectations result in less challenging classwork, acceptance of minimal performance levels and guidance away from rigorous academic disciplines. While it is widely understood that the decision to treat minority students differently is often unconscious, it can create a self-fulfilling prophecy nevertheless.

Other emphases for staff training include: teaching thinking skills, non-textbook approaches to instruction, curriculum review and development, improving classroom management, fostering student discipline, effective homework policies, and building relationships with parents.

8. Tutoring

Tutorial assistance is provided to students to supplement their regular school coursework, particularly in mathematics, science, communications, and study skills.

Some schools may already offer tutoring services. If so, the precollege program administrator can arrange for participating students to take advantage of existing opportunities, and can supplement the tutorial program with volunteers—minimizing costs to the program.

Two complementary objectives of the tutoring component are to help students reach and maintain an established achievement level, and to provide enrichment instruction not offered by the

Figure 5:1

■ **Enrichment Component/Program Component Activity Matrix**

	Program Components				
Enrichment Component	**In-School Program**	**After-School Program**	**Saturday Program**	**Summer Program**	**Other/ Special**
Counseling/ Advising	X	X	X	X	X
Parental Involvement					X
Role Modeling	X	X	X	X	X
Student Achievement Recognition	X		X	X	X
Student Projects	X	X	X	X	X
Summer Enrichment Programs				X	
Teacher/ Curriculum Improvement	X	X		X	
Tutoring	X	X	X	X	X

schools. Developing good study skills and preparation for test taking—especially for the SATs and ACTs—are also worthwhile tutoring activities.

Capitalize on the positive influence of student social relationships by organizing study groups and peer tutoring sessions. Several established precollege minority engineering programs have even clustered their students in math, science and English courses within their target schools, an effective means of advancing academic and motivational preparedness through group psychology.

Given the fact that students often become reliant on tutoring, however, activities should be carefully designed to promote independent learning.

Figure 5.1 presents each of the eight enrichment components with the types of programs most suitable for delivering these services.

After selecting the enrichment components your program will offer, the Program Design Committee shifts gears to develop student performance goals and objectives (see "How is the program best managed?" in Chapter Six and Appendix I), and recommended activities for each component. Because available resources may keep you from initiating all activities at the outset of your program, set priorities and implement services accordingly.

■ Where will the program get its funds?

The job of the Resource Development Committee is to secure the money, goods and services needed to sustain your program through its first year of operation. Essentially, this means budgeting and fund raising.

One approach is to determine the costs of planned activities and then to launch a fund-raising campaign to meet those costs. The first step is to develop a detailed operational budget assigning dollar amounts to each activity. A generally accepted means of determining and presenting the expenses of a not-for-profit organization (and for-profit ones as well) is a program budget. Each of the program elements is listed in one dimension and the cost of implementing it is listed in the other. The sum of these costs is the "ideal" or desired budget. A format for a program budget appropriate for a precollege minority engineering program is presented in Appendix G.

The major disadvantage to this approach is that it draws out the organizing process. Program budgeting translates activities into dollars and cents, which means the work of the Program Design Committee must be finalized before that of the Resource Development Committee can begin.

Another possibility is to raise as much money as possible without prior consideration of administrative and activity costs. Program budgeting is then carried out with services and activities competing for available funds.

Whichever approach you use, the "ideal" budget often will exceed available resources. Thus, committee members and program developers must be prepared to set priorities. Program budgeting, by forcing you to estimate the cost of each activity, is an excellent tool for prioritizing enrichment components. This technique also provides the basis for a management information system, which can be used to account for and control costs. Details on not-for-profit accounting are best obtained from an accountant. Consider consulting an accountant from one of your collaborating organizations, the office of a local accounting firm, or the American Institute of Certified Public Accountants.

As you budget, keep in mind that the financial resources required to meet the costs of managing and implementing program activities can be minimized by in-kind contributions. As a collective endeavor, several of your collaborating and supporting organizations might agree to provide the program with professional and support services, office space, furnishings and equipment, telephone services and utilities. Even if your program is not instituted as a subunit of one of your collaborators, try to find a host organization that is willing and able to contribute space and corresponding services, with or without assistance from others. To facilitate future planning, determine at the outset whether these gifts are initial, transitional or continuing contributions.

If your program is established as a membership organization, your first sources of support are the members. In deciding upon membership dues, committee members should research the currrent amounts of collaborators' contributions to other community activities. Then you might establish minimum membership dues—financial and/or in-kind contributions you will expect of the various membership classes of collaborating organizations. The membership classes are businesses, educational institutions, public institutions, community organizations, and affiliates.

Differentiated membership dues can be based upon a variety of criteria: number of employees or organizational membership, profit levels, or average amount of community contributions. In setting minimum financial contributions expected of businesses, committee members should be mindful of the fact that for-profit enterprises are subject to economic fluctuations that have an impact on their ability to donate. Anticipate and make allowances for changes in business cycles, and plan to negotiate with the managers responsible for local contributions before determining membership dues.

In order to create uniformity in the measurement of in-kind contributions, establish your own valuations. Value contributions of a physical nature at cost if new, or at fair market value if used. Services such as transportation, printing and utilities should also be valued at cost. Staff members on loan from other organizations who spend at least half-time on program activities should be valued at their proportional salary levels. Occasional human resources and volunteers might be valued at local hourly rates for professional consultants or local hourly rates for paraprofessionals and support staff, as appropriate.

Next, ascertain the levels of financial and in-kind contributions you can expect from supporting organizations. Since they're not members of your association, their donations are purely voluntary. Supporting organizations that are able to make monetary contributions will probably require formal written requests.

To locate other potential funding sources, research federal and state agencies, and foundations that might be interested in funding a precollege minority engineering program. *Grants for Science Programs*, published by the Foundation Center, is a good reference. Solicitations from such sources will most likely require the writing of grant proposals. Grant writing is a specialized job that would be most effectively undertaken by a subcommittee of both the Resource Development and Program Design Committees.

If possible, select subcommittee members who are experienced in the art of writing grant proposals. If committee members are all neophytes, excellent references are available. The proposal writing outline presented in Appendix H was derived from *Program Planning and Proposal Writing* by Norton J. Kiritz. Be aware that some government agencies and foundations have special formats they want you to follow when applying for their grants.

Don't forget to approach philanthropists and other individuals who live in your target area or who regularly support activities in your community. Most giving in this country is not done by foundations and corporations, but by individuals.

6

Chapter Six: Administering the Program

The administrative requirements of any new program will, of course, depend upon the scope of program activities. Small-scale activities can be administered by a part-time coordinator and implemented by a host of volunteers. In a membership organization, many of the volunteers will be employees or members of the collaborating or supporting organizations. A truly comprehensive program will require a full-time executive director, a complement of full-time professional and support staff members, and a contingent of part-time professional and paraprofessional employees and volunteers.

■ Who runs the day-to-day program operations?

As recommended in Chapter Three, it's important that the Governance/Administration Committee give serious thought to hiring a full-time administrator at the start of your initiative. Because program activities will probably begin on a small scale, the director will have time to plan and cultivate the expansion of the program, its supporters, and the interest of the community.

It is the organization's board of directors or governing body that actually employs the chief administrator to be responsible for day-to-day operations. The board must grant the administrator the liberty to fulfill her responsibilities, and then serve as her supervisor and evaluate her performance. The board must also approve an organizational structure with clear lines of responsibilities and authority.

Generally carrying the title of director or executive director, the administrator is the most important individual to the survival and growth of the program. She sets its tone on an ongoing basis, not only among program staff but also with outside contacts. She must fully understand the philosophy of the program and make sure that every activity, every contact and every written document faithfully adheres to it.

She is also in charge of ensuring that tasks are completed, that services are provided, that resources are developed and nurtured. We outline her responsibilities in Figure 6:1.

Figure 6:1

■ **Responsibilities of the Program Administrator**

Admission of Targeted Students
Student identification, recruitment and selection

Conducting and Evaluating Student Participants' Needs Assessment

Establishing and Achieving Student Performance Goals and Objectives

Human Resource Management
Staff selection, utilization and development

Volunteer recruitment, utilization and development

Program Orientations
Students

Staff and volunteers

Target schools' personnel

Participants' parents

Community at large

Budgeting and Fiscal Management

Office and Records Management

Public Relations and Publicity

Facilities Management

Resource Development

Program Evaluations
Student performance

Staff/Volunteers

Program/Office procedures

Program design

Reporting to the Board of Directors and Organizational Membership

The multifaceted role played by the program administrator underscores the need for a skilled professional in this position, and illustrates the importance of the membership's support and assistance. It is highly improbable that the administrator will be able to accomplish all of her designated tasks effectively and efficiently. Her workload can be considerably alleviated by executive, standing and ad hoc committees which can carry out specific jobs in the overall management of program activities. There may also be other staff and volunteers who are delegated particular responsibilities. However, ultimate accountability for program activities rests with the administrator, who is answerable to the board.

While primarily concerned with the operation of program activities, the administrator also must maintain the program's mission and philosophy. Mis-directions and misinterpretations from within and outside the organization can have disastrous consequences. Programs have been purposefully diverted from their intented course—co-opted to serve other populations or to address a different set of concerns. In short, the director sees that your program stays on target—in spirit as well as in action.

■ How is the program best managed?

An operational plan is an administrator's most effective tool in promoting efficient management of program activities.

The model we present in this handbook is articulated from the perspective of an integrated systems approach to educational management. This is a method developed for business management that has been adapted widely by educational and other nonprofit organizations. It works well for planning, organizing and controlling precollege programs.

After your organization has established its goals, an operational or action plan outlines in detail the management and administrative functions needed to plan and implement your program. With an operational plan, you accomplish two things:

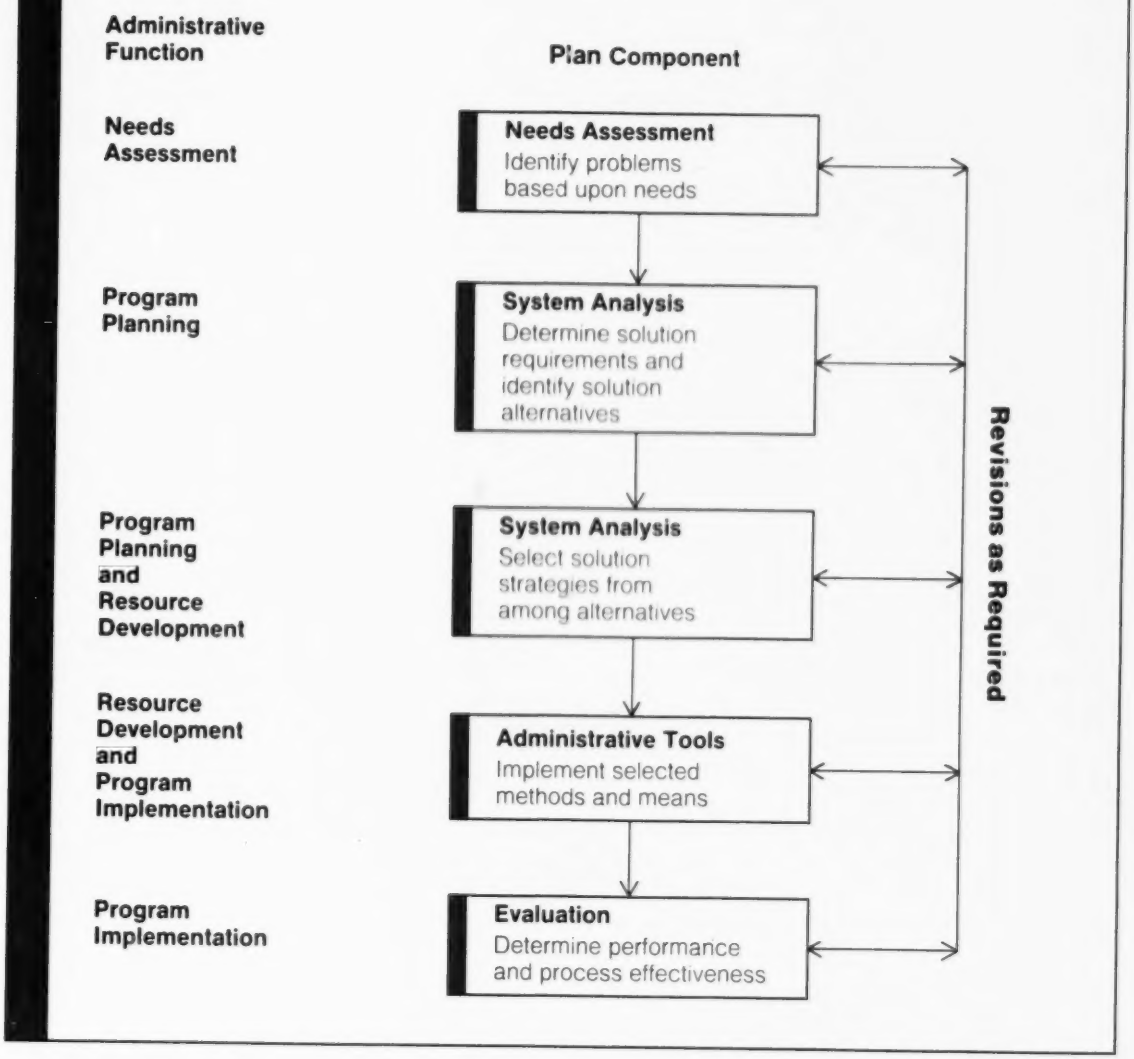
- you provide a common nomenclature for the program's managerial and administrative activities, and
- you establish accountability.

Once your plan is written, there is no need to second guess program planning goals, measurable objectives, methodologies, procedures, or evaluation activities. Detailing the managerial responsibilities of the organization's board of directors and various committees as well as the duties of the program administrator also allows for clarity.

Figure 6:2 illustrates a comprehensive operational plan written in an integrated systems approach.

Figure 6:2

■ **Operational Plan**



If you do not need as complex a plan as this, you can follow a single system approach to detail all program operations.

We suggest you write your plan in a Management by Objectives (MBO) format. MBO is a system used to improve the probability that the goals you set will be achieved. It delegates functions and requires ongoing progress reports, giving the administrator an excellent management tool.

When you apply an operational plan for an educational program to your work, develop student performance goals for each enrichment component. Then, set process goals, which will detail the managerial and administrative tasks required for student activities such as those outlined in Figure 5:1. Other definitions and illustrations are presented in Appendix I.

■ Staff orientation

A precollege minority engineering program provides services to target students with the aim of enhancing their academic and motivational preparedness to pursue engineering or other scientific studies at the post-secondary level. Extremely important to the success of this kind

of enterprise are the attitude, behavior and competence your facilitators bring to their work.

Education, as a human service, can be simply defined as the facilitation of learning. Therefore, it is important for the program administrator to be concerned about the ability of the program staff—whether paid employees or volunteers—to make the learning process engaging, enlightening and enjoyable.

A low-budget intervention program is rarely in a position to be truly selective about the people it chooses to conduct program activities. Often, programs rely upon volunteers and the existing personnel within target schools. Nevertheless, there are many ways to maximize the effectiveness of everyone who will interact with program students.

Each facilitator's performance in an educational program is determined in part by his character—attitudes, behavior and competence—and in part by the program's culture. Theoretically, the program culture, derived from its mission and philosophy, will embody an unselfish devotion to the welfare of the students serviced. The director's job in creating staff orientation sessions is to convey that culture to all participants and to shape their attitudes as well.

In this context, the term "orientation" has two important meanings:

- a predisposition or frame of reference that influences reactions to certain stimuli, situations or behaviors
- the process of initiating individuals to a work or activity situation, and of instructing them about procedures, rules, regulations, responsibilities, expectations and standards

Before you implement your student activities, organize an orientation session for facilitators during which you will discuss their roles in the program. In addition to specifying responsibilities, lines of communication, and mechanisms for accountability, make sure your facilitators are aware of how important it is for them to understand and be sensitive to the various cultures of the targeted population. Emphasize the meaningfulness of their services to the students and others in the program, and the satisfactions and growth their program experiences will bring to them personally.

Invite organizational members to attend the orientation sessions, when possible, for their own edification and to demonstrate the importance of these sessions to the success of the program. If the program administrator needs help in developing or implementing staff orientation sessions, there is expertise available from collaborating minority organizations or the schools of education or human development at collaborating universities.

Orientation is a mechanism of socialization and an ongoing process that will continue for the duration of the program. One of its most important goals is to develop and maintain an *espirit de corps* among staff members. The principles of organizational theory and group dynamics discussed in Chapter Three are useful in creating this kind of program culture.

■ Leadership style

Throughout the performance of his responsibilities, the program administrator should remember that leadership style is a critical determinant of staff effectiveness.

If your program has adopted MBO as a management tool, the administrator might use participative management by objective (PMBO) in working with facilitators. PMBO is a middle ground approach to leadership that is very appropriate for supplementary educational programs. Management decides on the goals, objectives, and the essence of the methodologies, and allows facilitators a significant degree of flexibility in choosing and implementing activities. The PMBO style encourages facilitators to be experimental and innovative by letting staff know that their contributions are valued. The PMBO manager arranges, on a frequent basis, to get informal and formal feedback about staff concerns, as well as status reports on progress toward attaining program goals and objectives.

By using a participatory approach to administration, the program director can strike a comfortable balance between sufficient control over the implementation of activities and the efficient use of human resources. The morale and motivation of both paid staff and volunteers have a tremendous impact on their willingness to expend efforts to achieve program goals. Given that improperly or poorly imposed management can demoralize all personnel, effective managers must be responsive to their facilitators and provide ways for them to achieve some measure of fulfillment within the social system you have established—the program.

■ New approaches to education

One final domain for the directors of new and established precollege minority engineering programs is to see that your work with students remains on the cutting edge of educational technology. Be aware that new strategies to improve education generally and the education of underrepresented minority students in particular are being developed by educators and researchers around the country.

In *A Report to the Field*, a recent assessment of the Minority Engineering Education Effort by Edmund W. Gordon, et al., the lack of attention being paid to these developments is made clear[11]:

> *There is a relatively untapped new knowledge base and technology for pedagogy, drawn from the cognitive sciences, which shows interesting potential for meeting some of the academic development problems in this area. The application of this new knowledge and technology is lagging behind in engineering, as in education in general. Yet, the development of intellect and intellectual skills which may be fundamental to further expansion of the minority pool is at least promised in this new work.*

Of particular interest to program administrators who wish to broaden their understanding of this new knowledge base and technology are topics such as:

- cognitive development
- problem-solving instruction
- organization of the curriculum
- learning activities of students and styles of learning
- the affective domain of learning
- teaching strategies, approaches and methodologies
- organizing the setting for learning, and
- new instructional materials that students find exciting and engaging

Another of Gordon's findings may yet provide us with the next wave of minority engineering programs. Addressing the facilitation of student academic development and academic talent pool expansion, Dr. Gordon says two extremely important predictors of future success are[12]:

> *exposure early in the life of the child (ages 5 or 6 to 12 years) to rewarding hands-on experiences in mathematics, science and technology with ample opportunities for exploring, discovering, and questioning relationships between concepts and materials, [and]*
>
> *early and continually mediated learning experiences in which learners are guided in their identification of salient and distinguishing features, lawful relationships, taxonomic indicators, and other aids to information processing, which also serve to maintain a balance between challenge and frustration in learning.*

Several existing precollege minority engineering programs have recently established elementary level components to provide intervention along these lines. It behooves everyone concerned with the success of the Minority Engineering Education Effort to follow their progress and to prepare themselves to replicate, expand and improve elementary level activities that advance the academic and motivational preparedness of target students.

Postscript—Announcing Your Initiative to the Community

Starting a new precollege minority engineering program is a remarkable achievement. You, the developers of the initiative, should be eager to share this news with your community. After you've become a legal entity and finalized all your development plans, it's time to hold a press conference. Organizing this conference could be the first task of a Public Relations/Publicity Standing Committee.

As an event, the press conference does much more than tell the world of your existence. It helps to establish your program's credibility and gives your collaborators, supporters, staff, volunteers and students the feeling that they are involved in an important and worthwhile endeavor. As a public relations tool, a press conference can also be used to attract new students, volunteers, and funders.

Choose a convenient location with ample space—a school auditorium, a corporate dining room, even City Hall if you can arrange it, would be appropriate. Invite the education editors of local newspapers and electronic media at least two weeks in advance and follow up with phone calls two days before the event. Don't forget to include the minority press, the editors of community newsletters, university press, college campus newspapers, public relations officers from participating businesses, and even the editors of local high school newspapers. Of course, everyone involved in the development of the program should be welcome to attend.

If your local media pool is limited, the press conference can also serve as a public announcement. Invite all local organizations interested in educational matters and representatives of each of the groups that helped you along the way.

Plan an agenda that allows for informal mingling before short presentations on the development of the initiative, your short-term goals and long-range plans, and an enthusiastic thanks to your donors and supporters. These presentations should be made by:

- the initial planners
- the chairperson of the board of directors
- the superintendent of schools or a representative of the board of education
- a collaborator from a local business who has been strongly involved in planning or funding program activities
- a collaborator from a community organization or higher education institution who has been very active in program development, and/or
- the program administrator

Now is the time for the program developers to exhibit all the excitement you've generated, all the satisfaction with your efforts to date, and all the hope you have for the future of the program and the students it will serve. Precollege minority engineering programs have a solid performance record across the nation in creating new academic and career opportunities for their students. By establishing a local program, these opportunities are being made available in your community. Certainly, all of the participants in this new endeavor have ample reason to be proud.

Footnotes

1. **Demographic Trends and the Scientific and Engineering Work Force: A Technical Memorandum** (Office of Technology Assessment: Washington, D.C., December 1985), p. 6.

2. **Engineering Education and Practice in the United States: Foundations of Our Techno-Economic Future** (National Academy Press: Washington, D.C., 1985), p. 27.

3. Ibid., pp. 27-28.

4. **Professional Women and Minorities: A Manpower Data Resource Service** (Commission on Professionals in Science and Technology: Washington, D.C., 1986), p. 164.

5. DeAnna Banks Beane, **Mathematics and Science: Critical Filters for the Future of Minority Students** (The Mid-Atlantic Center for Race Equity—The American University: Washington, D.C., 1985).

6. Seymour Lusterman, **Minorities in Engineering: The Corporate Role** (The Conference Board: New York, New York, 1979), p. 25.

7. **Readings in Community Organization Practice,** edited by Ralph M. Kramer and Harry Specht (Prentice-Hall: Englewood Cliffs, New Jersey, 1969), pp. 8-9.

8. **Mathematics and Science: Critical Filters for the Future of Minority Students,** op. cit., pp. 26-27.

9. **Readings in Community Organization Practice,** op. cit.

10. **Promoting Success Through Collaborative Ventures in Precollege Science and Mathematics** (National Association of Precollege Directors: New York, New York, 1985), p. 8.

11. Edmund W. Gordon, et al., **A Report to the Field** (NACME, Inc: New York, New York, 1987), p. 4.

12. Ibid., pp. 2-3.

■ **Appendix A**

Directory: National Association of Precollege Directors

Experienced administrators of NAPD programs would be excellent sources to assist initiators in planning and implementation of program activities. The same is true of the National Association of Minority Engineering Program Administrators (see Appendix B), an organization of precollege and college program personnel and industry supporters.

■ **Buffalo Area Engineering Awareness for Minorities (BEAM)**
Mr. James Legge, Executive Director
SUNY at Buffalo
221 Fronczak Hall
Buffalo, New York 14260
(716) 636-2768

■ **Chicago Area Pre-College Engineering Program (CAPCEP)**
Ms. Deborah A. Minor, Executive Director
300 West Adams Street, Room 614
Chicago, Illinois 60606
(312) 726-4137

■ **Colorado Minority Engineering Association (CMEA)**
Mr. Miguel A. Garcia, Executive Director
University of Colorado at Denver
1100 14th Street, Room 517
Denver, Colorado 80202
(303) 556-2344

■ **Comprehensive Math and Science Program (CMSP)**
Dr. Gilbert Lopez, Director
Columbia University
School of Engineering and Applied Science
510 Mudd Building
New York, New York 10027
(212) 228-0950

■ **Detroit Area Pre-College Engineering Program (DAPCEP)**
Mr. Kenneth Hill, Executive Director
Rackham Memorial Building
60 Farnsworth
Detroit, Michigan 48202
(313) 831-3050

■ **District of Columbia Metropolitan Consortium for Minorities in Engineering (METCON)**
Dr. Elbert L. Cox, Executive Director
c/o Howard University
School of Engineering
2300 Sixth Street, N.W.
Washington, D.C. 20059
(202) 636-6627

■ **Forum to Advance Minorities in Engineering (FAME)**
Mr. Guizelous O. Molock, Executive Director
Montchanin Building
Ground Floor, Suite 4-3
100 West 10th Street
Wilmington, Delaware 19801
(302) 774-9270

■ **Gateway to Engineering, Science and Technology (GEST)**
Ms. Rose Daitsman, Director
University of Wisconsin at Milwaukee
P.O. Box 784
Milwaukee, Wisconsin 53201
(414) 963-5356

■ **Illinois Institute of Technology Minorities in Engineering Programs**
Dr. Reginald Jones, Executive Director
Commons Building
3200 South Wabash Avenue
Chicago, Illinois 60616
(312) 567-5111

■ **Louisiana Engineering Advancement Program (LEAP)**
Mr. George W. Baker, Executive Director
Xavier University
7325 Palmetto Street, Room 217
New Orleans, Louisiana 70125
(504) 483-7646

■ **Massachusetts Pre-Engineering Program for Minority Students, Inc. (MASSPEP)**
Mr. Robert Hayden, Executive Director
c/o Wentworth Institute of Technology
553 Huntington Avenue
Boston, Massachusetts 02115
(617) 427-7227

■ **Mathematics, Engineering and Science Achievement (MESA—California)**
Mr. Fred Easter, Statewide Director
University of California, Berkeley
Lawrence Hall of Science
Berkeley, California 94720
(415) 642-5064

■ **Mathematics, Engineering and Science Achievement (MESA—New Mexico)**
Mr. Patrick Lopez, Director
University of New Mexico
College of Engineering
Farris Engineering Center, Room 345F
Albuquerque, New Mexico 87131
(505) 277-5832

■ **Mathematics, Engineering and Science Achievement (MESA—Washington)**
Ms. Patricia MacGowan, Director
University of Washington
College of Engineering
353 Loew, FH-18
Seattle, Washington 98195
(206) 543-0562

■ **Mathematics & Science Education Network (MSEN) Pre-College Program**
Dr. Vinetta Jones, Director
University of North Carolina at Chapel Hill
201 Peabody Hall
Chapel Hill, North Carolina 27514
(919) 966-3256

■ **Philadelphia Regional Introduction for Minorities to Engineering (PRIME)**
Dr. Alexander Tobin, Executive Director
1700 Walnut Street—Suite 1201
Philadelphia, Pennsylvania 19103
(215) 893-8500

■ **Program for Rochester to Interest Students in Science and Math (PRIS²M)**
Ms. Constance Mitchell, Program Director
c/o Industrial Management Council
12 Mortimer Street
Rochester, New York 14604
(716) 244-8596

■ **Southeastern Consortium for Minorities in Engineering (SECME)**
Ms. Carolyn Chesnutt, Executive Director
c/o Georgia Institute of Technology
Savant Building, Room 208
225 North Avenue, N.W.
Atlanta, Georgia 30332
(404) 984-3314

■ **Texas Alliance for Minorities in Engineering (TAME)**
Mr. John S. Robottom, Executive Director
University of Texas at Arlington
College of Engineering
Box 19019—UTA Station
Arlington, Texas 76019
(817) 273-2571

■ **Union County College Minorities in Engineering Program (UCMEP)**
Mr. Robert Blount, Coordinator
1033 Springfield Avenue
Cranford, New Jersey 07016
(201) 276-9611

■ **Appendix B**

Resource Organizations

You may write to the organizations listed below requesting their list of publications, general information, and other services that might aid you in the development and/or implementation of your initiative. The services/products noted are only a partial listing of available resources.

Organization	Service/Product
■ **American Association for the Advancement of Science** Office of Opportunities in Science 1776 Massachusetts Avenue, N.W. Washington, D.C. 20036 (202) 467-5438	Research Clearinghouse and publications Educational programming
■ **American Association of Engineering Societies** 415 Second Street, N.E., Suite 200 Washington, D.C. 20002 (202) 546-2237	Engineering Manpower Commission (EMC) reports Other publications
■ **American Indian Science and Engineering Society** 1310 College Avenue, Suite 1220 Boulder, Colorado 80302 (303) 492-8658	Educational programming College student chapters Magazine
■ **American Society for Engineering Education** Eleven Dupont Circle Washington, D.C. 20036 (202) 293-7080	Guidance materials Newsletter
■ **American Society of Civil Engineers Field Services** 345 East 47th Street New York, New York 10017	Summer programs Educational materials
■ **Association for Supervision and Curriculum Development** 225 North Washington Street Alexandria, Virginia 22314 (703) 549-9110	Curriculum materials
■ **Association for Women in Mathematics** Wellesley College P.O. Box 178 Wellesley, Massachusetts 02181	Speakers bureau
■ **Association of Science-Technology Centers** 1413 K Street, N.W., Tenth Floor Washington, D.C. 20005 (202) 371-1171	Teacher training Enrichment programs Curriculum development
■ **Black Collegiate Services, Inc.** 1240 South Broad Street New Orleans, Louisiana 70125 (504) 821-5694	Magazine

■ **Career Communications Group, Inc.**
280 South Sadler Avenue
Los Angeles, CA 90022
(213) 727-9914

Magazine

■ **Center for Social Organization of Schools**
Johns Hopkins University
3505 North Charles Street
Baltimore, Maryland 21218
(301) 338-8249

Research
Learning materials

■ **The College Board Educational EQuality Project**
45 Columbus Avenue
New York, New York 10023
(212) 713-8000

Research
Teacher and student learning materials

■ **COMETS**
University of Kansas
School of Education
205 Bailey Hall
Lawrence, Kansas 66045
(913) 864-4435

Science modules

■ **COSMOS Corporation**
1735 Eye Street, N.W., Suite 613
Washington, D.C. 20006
(202) 728-3939

Research and training
Publications
Information dissemination

■ **Curriculum Development Associates, Inc.**
1211 Connecticut Avenue, N.W., Suite 414
Washington, D.C. 20036
(202) 293-1760

Learning modules
Educational materials

■ **Discovery Learning, Inc.**
1776 Peachtree Street, N.W., Suite 620N
Atlanta, Georgia 30309
(404) 881-8200

Motivational and teacher materials

■ **Elementary School Center**
2 East 103rd Street
New York, New York 10029
(212) 289-5929

Resource center

■ **Equal Opportunity Publications**
44 Broadway
Greenlawn, New York 11740
(516) 261-8899

Magazines
Other publications

■ **General Electric Company**
Educational Communications Program
W2H1
Fairfield, Connecticut 06431
(203) 373-2211

Educational and career materials

■ **Girl Scouts of the U.S.A.**
830 Third Avenue
New York, New York 10022
(212) 940-7500

Outreach program

■ **Girls Club of America, Inc.**
Operation SMART
205 Lexington Avenue
New York, New York 10016
(212) 689-3700

Outreach program—math/science emphasis

■ **GTE Corporation**
Corporate Contributions
One Stamford Forum
Stamford, Connecticut 06904
(203) 965-2000

Teacher development
Educational materials

■ **INROADS Inc.**
1221 Locust, Suite 755
St. Louis, Missouri 63103
(314) 241-7330

Precollege and college programs

■ **The Institute of Electrical and Electronics Engineers, Inc.**
1111 19th Street, N.W.
Washington, D.C. 20036
(202) 785-0017

"Education: The Key to America's Future"—a slide presentation

■ **JETS, Inc.**
1420 King Street
Alexandria, Virginia 22315
(703) 548-JETS

School science/math clubs
Tests and Career information
Minority Introduction to Engineering (MITE) programs

■ **Lawrence Hall of Science—EQUALS**
University of California—Berkeley
Berkeley, California 94720
(415) 642-1823

Learning materials
Teacher training
Curriculum research and development

■ **League of United Latin American Citizens National Educational Service Centers, Inc.**
400 First Street, N.W., Suite 716
Washington, D.C. 20001
(202) 347-1652

Educational programming
Counseling services

■ **Mathematical Association of America**
1529 18th Street, N.W.
Washington, D.C. 20036
(202) 387-5200

Career materials

■ **Mexican-American Engineering Society**
P.O. Box 3520
Fullerton, California 92534
(213) 217-3517

Educational programming
College student chapters

■ **The Mid-Atlantic Center for Race Equity**
The American University
5010 Wisconsin Avenue, N.W., Suite 310
Washington, D.C. 20016
(202) 885-7555

Research
Educational materials

■ **Minorities and Mathematics Network**
c/o Helen Cheek
Oklahoma State University
Stillwater, Oklahoma 74078
(405) 624-7119

Resource information
Newsletter

■ **Minority Women in Science, Inc.**
P.O. Box 28440
Washington, D.C. 20005

Role models
Workshops
Career information

■ **National Association for the Advancement of Colored People**
4805 Mt. Hope Drive
Baltimore, Maryland 21215
(301) 358-8900

Educational programming

■ **National Association of Elementary School Principals**
1615 Duke Street
Alexandria, Virginia 22314
(703) 684-3345

Publications

■ **National Association of Industry-Education Cooperation, Inc.**
235 Hendricks Boulevard
Buffalo, New York 14226
(716) 342-8070

Alliance development
Clearinghouse
Educational materials

■ **National Association of Minority Engineering Program Administrators**
c/o University of Oklahoma
202 West Boyd, Room 107
Norman, Oklahoma 73019

Magazine
Training workshops
Resource information

■ **National Community Education Association**
119 North Payne Street
Alexandria, Virginia 22314
(703) 683-6232

Networking activities
Publications

■ **National Consortium for Graduate Degrees for Minorities in Engineering**
P.O. Box 537
Notre Dame, Indiana 46556
(219) 239-7183

Graduate fellowship program

■ **National Council of Negro Women**
701 North Fairfax Street
Alexandria, Virginia 22314
(703) 371-9826

Educational programming

■ **National Council of Teachers of Mathematics**
1906 Association Drive
Reston, Virginia 22091
(703) 620-9840

Newsletter
Educational materials

■ **National Diffusion Network Division, U.S. Department of Education**
1200 19th Street, N.W., Room 714F
Washington, D.C. 20036
(202) 653-7000

Publications
Resource information

■ **National Education Association**
1201 16th Street, N.W.
Washington, D.C. 20036
(202) 833-4000

Publications
Resource information
Teacher/curriculum development

■ **National School Volunteer Program**
701 North Fairfax Street
Alexandria, Virginia 22314
(703) 836-4880

Training and materials
Technical assistance

■ **National Science Foundation**
Directorate for Engineering
1800 G Street, N.W.
Washington, D.C. 20550
(202) 357-7452

Teacher development
Instructional materials
Research and publications

■ **National Science Resources Center**
National Academy of Sciences—Smithsonian Institution
2101 Constitution Avenue
Washington, D.C. 20418
(202) 334-3600

Educational materials

■ **National Science Teachers Association**
Office of Special Publications
1742 Connecticut Avenue, N.W.
Washington, D.C. 20009
(202) 328-5800

Publications
Magazine

■ **National Society of Black Engineers**
1101 Connecticut Avenue, N.W., Suite 700
Washington, D.C. 20036
(202) 857-1100

College student chapters
Role models
Journal

■ **National Society of Professional Engineers**
2029 K Street, N.W.
Washington, D.C. 20006
(202) 463-2310

MATHCOUNTS—student competitions

■ **National Technical Association**
Suite 701, Southern Building
1425 H Street, N.W.
Washington, D.C. 20005
(202) 638-6370

Informational services

■ **The National Urban Coalition**
1120 G Street, N.W., Suite 900
Washington, D.C. 20005
(202) 628-2981

Educational programming
Family learning centers

■ **National Urban League, Inc.**
500 East 62nd Street
New York, New York 10021
(212) 310-9000

Educational programming

■ **Native American Science Education Association**
1228 M Street, N.W.
Washington, D.C. 20005
(202) 638-7066

Clearinghouse
Curriculum
Resource information
Conferences/workshops

■ **Partnerships Data Net, Inc.**
1111 North 19th Street, Suite 500
Arlington, Virginia 22209
(703) 276-1165

Information resource center
Referral services

■ **Public Education Fund**
600 Grant Street
Pittsburgh, Pennsylvania 15219
(412) 391-3235

Technical assistance

■ **Reading Is Fundamental**
600 Maryland Avenue, S.W., Suite 500
Washington, D.C. 20024
(202) 287-3220

Publications
Technical assistance

■ **Research Triangle Institute**
P.O. Box 12194
Research Triangle Park, North Carolina 27709
(919) 541-6000

Classroom activities materials—career program

■ **Society of Hispanic Professional Engineers**
P.O. Box 48
Los Angeles, California 90053

College student chapters
Speakers bureau
Newsletter
Magazine

■ **Society of Women Engineers**
345 East 47th Street
New York, New York 10017
(212) 705-7855

Speakers bureau
Informational services

■ **Technical Education Research Centers**
1696 Massachusetts Avenue
Cambridge, Massachusetts 02138
(617) 547-0430

Educational materials
Technical assistance

■ **Triangle Coalition for Science and Technology Education**
c/o National Science Teachers Association
5112 Berwyn Road, 3rd floor
College Park, Maryland 20740
(301) 220-0871

Promotes establishment of local alliances that aid local science education
Newsletter

■ **U.S. Department of Energy**
Technical Information Center
P.O. Box 62
Oak Ridge, Tennessee 37830
(615) 576-1222

Publications
Career information
Pre-Freshman Engineering Programs (PREP)

■ **Westinghouse Electric Corporation**
Contributions and Community Affairs
11 Stanwix Street, Room 1041
Pittsburgh, Pennsylvania 15222
(412) 244-2000

Engineering career materials

■ **Women's Action Alliance, Inc.**
370 Lexington Avenue, Room 603
New York, New York 10017
(212) 532-8830

Computer Equity Training Project

■ **Young Astronaut Program**
White House Office of Private Sector Initiatives
1211 Connecticut Avenue, N.W., Suite 800
Washington, D.C. 20036
(202) 684-1984

Curriculum materials
Student chapters

■ **Appendix C-1**

Publications Available from NACME

■ **A Report to the Field** is a descriptive analysis of programs and trends in minority engineering education and probably the most significant assessment of the minority engineering effort prepared to date. The report's importance lies not only in its description of the current status of the effort, but in its implications for the directions that must be undertaken in the future if success is to be achieved.

Written by Dr. Edmund W. Gordon, et al.
Published 1987
$12.50 per copy

■ **Design for Excellence: How to Study Smartly** is a skills training book that was created to help students working within rigorous academic environments to reach the highest levels of learning possible. Among other concepts, it teaches students to set priorities, to use time efficiently and to recognize the need for outside help.

Written by Dr. Lloyd M. Cooke
Copyright 1984, Revised 1986
$1.00 per copy; bulk orders of 25 or more are discounted 25 percent.

■ **Engineering, Your Key to the 21st Century** is a poster/brochure package that specifically targets junior high school students. The material uses advertising strategy to promote interest in engineering careers and awareness of the necessary four-year high school science and math prerequisities. A 16" x 22" poster is sent with every 25 brochures.

Published 1986
$15.00 per hundred brochures. One poster is furnished with every 25 brochures.

■ **Financial Aid Unscrambled: A Guide for Minority Engineering Students** is a 24-page handbook that explains the maze of forms and applications that confronts students seeking scholarships, grants, and loans. It also provides a list of financial aid opportunities that are specific to minority students in full-time engineering or science and math-based majors.

Published 1986
$1.00 per copy; bulk orders of 25 or more are discounted 25 percent.

■ **Improving the Retention and Graduation of Minorities in Engineering** is a comprehensive, step-by-step guide to effective support services delivery that improves the success rate of minority students enrolled in colleges of engineering. It outlines easily replicated techniques that were developed and refined during more than a decade of work in college level minority engineering programs nationwide.

Funded by NACME as a project of the National Association of Minority Engineering Program Administrators, the handbook includes:

—an analysis of the retention barriers that prevent minority students from successfully completing degree programs;
—detailed operating procedures for each component of a model program; and
—an easy-to-use checklist for evaluating a minority engineering program.

Edited by Dr. Raymond B. Landis
Published 1985
$12.50 per copy

■ **MEPs/USA, The Directory of Precollege and University Minority Engineering Programs** is a complete listing of full-time and part-time minority engineering programs throughout the country. Listings are alphabetical by state and are cross-referenced by acronym and by name of participating program personnel.

Published 1986
$4.00 per copy

■ **Minorities in Engineering** is an envelope-size descriptive brochure on engineering with emphasis on motivation, precollege preparation, and planning. Included are descriptions of the various fields of engineering, as well as alternative uses of an engineering degree.

Published 1984
$6.00 per 100 copies

■ **NACME Statistical Report** presents comprehensive data on minority enrollment and graduation in engineering from 1974 to 1985. It also provides a statistical study of NACME's Incentive Grants Program and a directory of university personnel working in minority engineering programs.

Published 1986
$12.50 per copy

■ **Promoting Success Through Collaborative Ventures in Precollege Science and Mathematics** offers a global view of the results of a decade of work at the precollege level to increase the pool of minority students who pursue engineering studies. It documents the history and current work of the NAPD, a coalition of 19 independent and college-based programs whose efforts over the last ten years have produced models of educational intervention that are effective in fostering student achievement in mathematics and science, and an awareness of engineering careers.

Prepared by the National Association of Precollege Directors
Published 1985
64 pages
Single copies—$5.00 each, 2-9 copies—$4.50 each, 10 or more copies—$4.00 each

■ **Students' Guide to Engineering Schools** contains descriptions of every undergraduate engineering college in the United States with at least one curriculum accredited by the Accreditation Board for Engineering and Technology. All information is listed in easy-to-follow chart format which details minority enrollment, admissions dates, engineering curricula offered, support activities and financial aid.

1986 edition
Individual copies free
$15.00 per 100 copies

■ **Appendix C-2**

Related How-To Publications

■ **A Guide to Elementary Science Program Improvement**
National Science Resources Center
National Academy of Sciences—Smithsonian Institution
2101 Constitution Avenue
Washington, D.C. 20418
(202) 334-3600

■ **A Sure Bet...Business and Education Together**
California Chamber of Commerce
1027 Tenth Street
Sacramento, California 95808
(916) 444-6670

■ **Coordinating Your School Volunteer Program**
by Susanne E. Taranto
VORT Corporation
P.O. Box 60132
Palo Alto, California 94306
(415) 322-8282

■ **Corporate Community Involvement**
Partnerships Data Net
1111 North 19th Street, Suite 500
Arlington, Virginia 22209
(804) 276-1165

■ **The Doable Dozen**
National Community Education Association
119 North Payne Street
Alexandria, Virginia 22314
(703) 683-6232

■ **Grants for Science Programs**
The Foundation Center
79 Fifth Avenue
New York, New York 10003
(212) 620-4230

■ **Handbook for Conducting Equity Activities in Mathematics Education**
National Council of Teachers of Mathematics
1906 Association Drive
Reston, Virginia 22091
(703) 620-9840

■ **The Harris Initiative for Quality Education: A Handbook for Action**
Harris Corporation
1025 West NASA Boulevard
Melbourne, Florida 32919
(305) 727-9100

■ **How to Form and Operate a Local Alliance**
Triangle Coalition for Science and Technology Education
c/o National Science Teachers Association
5112 Berwyn Road, 3rd Floor
College Park, Maryland 20740
(301) 220-0871

■ **Industry-Education-Labor Collaboration—An Action Guide for Collaborative Councils**
National Institute for Work and Learning
1200 18th Street, N.W., Suite 316
Washington, D.C. 20036
(202) 887-6800

■ **Non-Profit Corporations, Organizations, and Associations**
by Howard L. Oleck
Prentice-Hall, Inc.
Route 9W
Englewood Cliffs, New Jersey 07632
(201) 767-5937

■ **The Nonprofit Organization Handbook**
Tracy D. Connors, Editor-in-Chief
McGraw-Hill Book Company,
1221 Avenue of the Americas
New York, New York 10020
(212) 512-2000

■ **Partnership in Education: Education Trends of the Future**
Office of Private Sector Initiatives
U.S. Department of Education
400 Maryland Avenue, S.W., Room 4169
Washington, D.C. 20202
(202) 456-6676

■ **Partnerships in Education Directory**
Partnerships Data Net
1111 North 19th Street, Suite 500
Arlington, Virginia 22209
(804) 276-1165

■ **Partnerships in Science: Mini-Grant Program**
Triangle Coalition for Science and Technology Education
c/o National Science Teachers Association
5112 Berwyn Road, 3rd floor
College Park, Maryland 20740
(301) 220-0871

■ **Partners in Math and Science Education**
California Chamber of Commerce
1027 Tenth Street
Sacramento, California 95808
(916) 444-6670

■ **School-Business Partnerships: Why Not? Laying the Foundation for Successful Programs**
by Santee C. Ruffin, Jr.
National Association of Secondary School Principals
1904 Association Drive
Reston, Virginia 22091
(804) 860-0200

■ **School Partnerships Handbook**
by Susan D. Otterbourg
Prentice-Hall, Inc.
Route 9W
Englewood Cliffs, New Jersey 07632
(201) 767-5937

■ **Science and Mathematics Education: A Guide for Chapters and Clubs**
Sigma XI, The Scientific Research Society
345 Whitney Avenue
New Haven, Connecticut 06511
(203) 624-9883

■ **Appendix D**

Community Needs Assessment: Demographic and Academic Profiles

■ **Form 1**
Student Demographics: Public School System Populations by Ethnicity

	Grade Levels			
Ethnic Group	**K—5**	**6—8**	**9—12**	**Total**
White				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
Black				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
Mexican-American				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
Puerto Rican				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
American Indian				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
Others				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
Total				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____

■ **Appendix D**

Community Needs Assessment: Demographic and Academic Profiles

■ **Form 2**
Student Demographics: Junior High School Populations by Ethnicity

	Junior High Schools			
Ethnic Group	**Martha Custis**	**Abigail Smith**	**Martha Skelton**	**Dorothea Payne**
White				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
Black				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
Mexican-American				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
Puerto Rican				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
American Indian				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
Others				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
Total	_____	_____	_____	_____

■ **Appendix D**

Community Needs Assessment: Demographic and Academic Profiles

■ **Form 3**

Student Demographics: High School Populations by Ethnicity

Ethnic Group	High Schools			
	George Washington	John Adams	Thomas Jefferson	James Madison
White				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
Black				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
Mexican-American				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
Puerto Rican				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
American Indian				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
Others				
Number	_____	_____	_____	_____
Percent of Total	_____	_____	_____	_____
Total	_____	_____	_____	_____

■ **Appendix D**

Community Needs Assessment: Demographic and Academic Profiles

■ **Form 4**

Academic Preparedness: Basic Skills Proficiency by Ethnicity

Test: _____ Test Date(s): _____

	Basic Skills					
	Reading		**Writing**		**Computing**	
	Proficient	Not Prof.	Proficient	Not Prof.	Proficient	Not Prof.
Grade Level A						
White						
Black						
Mexican-American						
Puerto Rican						
American Indian						
Total						
Grade Level B						
White						
Black						
Mexican-American						
Puerto Rican						
American Indian						
Total						
Grade Level C						
White						
Black						
Mexican-American						
Puerto Rican						
American Indian						
Total						
Grade Level D						
White						
Black						
Mexican-American						
Puerto Rican						
American Indian						
Total						

■ **Appendix D**

Community Needs Assessment: Demographic and Academic Profiles

■ **Form 5**

Academic Preparedness: Students Enrolled in Selected Math and Science Courses by Ethnicity

School: _____

Subject	White	Black	Mexican American	Puerto Rican	American Indian
General Math					
Pre-Algebra					
Algebra I					
Algebra II					
Advanced Algebra					
Geometry					
Trigonometry					
Calculus					
Statistics					
Other Advanced Math					
Computer Science I					
Computer Science II					
Computer Science III					
General Science					
Physical Science					
Unified Science					
Geology					
Life Science					
Biology I					
Biology II					
Advanced Biology					
Anatomy					
Botany					
Zoology					
Other Life Science					
Chemistry I					
Chemistry II					
Advanced Chemistry					
Physics I					
Physics II					
Advanced Physics					
Biochemistry					
Biophysics					

■ **Appendix D**

Community Needs Assessment: Demographic and Academic Profiles

■ **Form 6**
Academic Preparedness: High School Curriculum Enrollments by Ethnicity

High School	Honors/Adv. Placement*	College Bound*	General	Vocational	Other
George Washington					
White					
Black					
Mexican-American					
Puerto Rican					
American Indian					
John Adams					
White					
Black					
Mexican-American					
Puerto Rican					
American Indian					
Thomas Jefferson					
White					
Black					
Mexican-American					
Puerto Rican					
American Indian					
James Madison					
White					
Black					
Mexican-American					
Puerto Rican					
American Indian					

*At least one-half of student's courses

■ **Appendix D**

Community Needs Assessment: Demographic and Academic Profiles

■ **Form 7**

Academic Preparedness: Students Who Enrolled in Post-Secondary Educational Institutions by Ethnicity—Class of 19??

	Post Secondary Enrollments							
	4 Year College		2 Year College		Other Post-Sec.		No Post-Sec.	
High School	Number	Percent	Number	Percent	Number	Percent	Number	Percent
George Washington								
White								
Black								
Mexican-American								
Puerto Rican								
American Indian								
Total								
John Adams								
White								
Black								
Mexican-American								
Puerto Rican								
American Indian								
Total								
Thomas Jefferson								
White								
Black								
Mexican-American								
Puerto Rican								
American Indian								
Total								
James Madison								
White								
Black								
Mexican-American								
Puerto Rican								
American Indian								
Total								

■ Appendix E

Program Models

■ Model A

Governance

Organized as a subunit of a local industrial council

Board of Directors	—24 members with alternates, elected by members to three-year terms—meets quarterly
Executive Committee	—8 members elected by Board of Directors to one-year terms—meets monthly
Standing Committees	—Membership Budget and Finance Public Relations Program Planning and Evaluation

Administration/Personnel

Administrator	—Executive Director (f/t)
Support Staff	—Administrative assistant (p/t)
Instructional Staff	—4 instructors (provided by school system) 3 engineers (provided by local businesses)
Other Paid Staff	—Director of Summer Institute Consultants Speakers Clerical workers (provided by post-secondary institutions and local businesses)
Volunteer Staff	—Board members, employees of member organizations and community residents

Student Program Activities

Total number of students serviced: 200

In School	—Demonstrations and guest speakers (collaborations with school systems, local businesses and community groups) —Counseling and advising
After School	—Student club meetings, project development and display (collaborations with school systems and program supporters)
Saturday Program	—Preparations for Science Fair participation
Summer Programs	—College orientation program (collaboration with post-secondary institutions and engineering college)

Student Program Activities (cont.)

—Science and computer camps (collaborations with engineering college and two other area colleges)

Field Trips/Excursions —Engineering facilities and post-secondary institutions

Program Components —Counseling and Advising; Recruitment; Role Modeling; Summer Programs; Student Projects, Fairs and Competitions; Teacher/Curriculum Improvement; Tutoring

Resource Development

Membership Dues —Vary depending upon nature and size of organization, but range from $100 to $3,000/year

Fund Raising Activities —Solicitations of grants from corporations and foundations; direct contact with funding sources made by administrator and key board members

Physical Resources —Program rents office space, furniture and equipment from local collaborating agency

—Instructional space: in-kind contributions from school systems

—Instructional space and equipment: in-kind contributions from post-secondary institutions

Human Resources —Administrator of Summer Institute for Teachers provided by host, rotated among three post-secondary institutions

—Program volunteers procured by program administrator and board members utilizing their community and corporate contacts

■ Appendix E

Program Models

■ Model B

Governance

Incorporated as nonprofit organization

Board of Directors	—35 members based on paid organizational membership dues—meets each month
Executive Committee	—4 board officers, 6 standing committee chairs and Executive Director
Standing Committees	—Program and Evaluation Student Community Development Finance and Development College Entrance Affiliated Program

Administration/Personnel

Administrator	—Executive Director (f/t)
Support Staff	—Secretary (f/t), student aide (p/t)
Instructional Staff	—1 professor (paid by engineering school) 23 faculty advisors and 3 teacher aides (provided by school systems)
Volunteer Staff	—75 business/industry employees

Student Program Activities

Total number of students serviced: 350

After-School	—Student clubs—tutoring, counseling/advising, speakers and student projects
Summer Programs	—Pre-Engineering Summer Program (collaboration with engineering college)
	—Summer Research Program (collaboration with engineering college)
	—Summer Physics Program (collaboration with post-secondary institution)
Student Fairs	—Students participate in local events
Field Trips/Excursions	—Student club activity—at least two, as many as four, each year to engineering facilities, post-secondary institutions and scientific entities
Program Components	—Counseling and Advising Student Projects and Fairs Summer Programs Recruitment Student Recognition Awards Tutoring

Resource Development

Membership Dues	—Annual dues based on number of employees of corporate members
Fund Raising Activities	—Grant proposals submitted to agencies and foundations
Physical Resources	—Office space and utilities provided by engineering college as in-kind contribution
	—Equipment and supplies purchased by program
	—Instructional space and equipment provided by school systems and post-secondary institutions
Human Resources	—Program volunteers are from member organizations—public school systems and area businesses

■ Appendix E

Program Models

■ Model C

Governance

Incorporated as nonprofit corporation

Board of Directors	—18 members elected by members of corporation to two-year terms—meets monthly	
Executive Committee	—4 officers of Board and 4 standing committee chairs	
Standing Committees	—Finance and Development Program and Evaluation	Communications Audit
Ad Hoc Committees	—Student Tracking Personnel	Bylaws

Administration/Personnel

Administrators	—Executive Director (f/t) Assistant Director (f/t)	
Support Staff	—Secretary (f/t) Bookkeeper (p/t)	Student assistants (2) (p/t) Coordinator of Summer Employment (p/t)
Instructional Staff	—18 teachers for in-school classes (paid by school system) 12 teachers for summer programs (paid by school system)	
Volunteer Staff	—A wide assortment of corporate and institutional employees, parents, students and community residents	

Student Program Activities

Total number of students serviced: 1000

In School	—Program students clustered in various pre-engineering classes (collaboration with school system)
After-School	—Tutorial program (collaboration with engineering college)
Saturday Programs	—Tutorial programs (collaborations with four engineering colleges)
	—Computer classes for 9th graders (collaboration with school system)
	—Computer classes for 11th graders (collaboration with corporation)

Summer Programs	—Residential and Commuting Programs 9th and 10th graders 10th and 11th graders 11th and 12th graders (collaborations with three engineering colleges)
Student Projects, Fairs and Competition	—Program students—7th through 12th graders—develop projects and participate in local and state fairs and student competitions
Employment/Co-op Activities	—Summer Bridge (Employment) Program for program graduates (collaborations with local businesses and city government)
Field Trips/Excursions	—Saturday and Summer Program include at least four trips annually to science or engineering facility (collaborations with school system, local businesses, and visited facilities)
Student Scholarships	—Student Advisory Committee and corporate sponsorship of scholarship program
Program Components	—Counseling and Advising Role Modeling Student Recognition Awards Teacher/Curriculum Improvement Student Fairs, Projects and Competitions Parental Involvement Summer Program Tutoring

Resource Development

Membership Dues	—Each corporate board member assessed a minimum of $5000/year
Fund Raising Activities	—Solicitations of grants from corporations and foundations
Physical Resources	—Office space: in-kind contribution from engineering college
	—Instructional space: in-kind contribution from school system
	—Instructional space and equipment: in-kind contributions from six colleges of engineering
	—Instructional space and equipment: in-kind contributions from local businesses
Human Resources	—Program volunteers procured by administrators and board members utilizing their community and business contacts
	—Speakers procured by administrators and board members utilizing their community and business contacts
	—Committee formed by local church to assist program administrators in development of grant proposals

■ **Appendix F-1**

Minority Engineering Enrollment Data

■ **Table 1:** Fall Semester Full-Time Minority Freshman Enrollment in Engineering

Year	Number	% Change From Prior Year	% of Total Freshman Enrollment	% Change From Prior Year
1973	2,249		4.4	
1974	3,424	+52.2	5.5	+25.0
1975	5,344	+56.1	7.2	+31.0
1976	6,309	+18.1	7.7	+6.9
1977	7,133	+13.1	8.1	+5.2
1978	8,382	+17.5	8.8	+8.6
1979	9,792	+16.8	9.5	+8.0
1980	10,399	+6.2	9.5	—
1981	11,116	+6.9	9.7	+2.1
1982	10,721	-3.6	9.4	-3.1
1983	10,603	-1.1	9.8	+4.3
1984	10,594	-0.1	10.2	+4.1
1985	10,588	-0.1	10.4	+1.9

■ **Table 2:** Fall Semester Full-Time Enrollment of Minority Students in Engineering

Year	Number	% Change From Prior Year	% of Total Enrollment	% Change From Prior Year
1973	7,444		4.1	
1974	9,837	+32.1	5.0	+22.0
1975	12,516	+27.2	5.5	+10.0
1976	15,412	+23.1	6.0	+9.1
1977	17,950	+16.5	6.3	+5.0
1978	20,737	+15.5	6.7	+6.3
1979	23,999	+15.7	7.1	+6.0
1980	26,127	+8.7	7.2	+1.4
1981	28,781	+10.2	7.5	+4.2
1982	29,359	+2.0	7.3	-2.7
1983	30,543	+4.0	7.6	+4.1
1984	30,829	+0.9	7.9	+3.9
1985	32,055	+4.0	8.3	+5.0

■ **Table 3:** Minority Students Receiving Bachelor's Degrees in Engineering

Year	Number	% Change From Prior Year	% of Total Graduates	% Change From Prior Year
1973	1,255		2.9	
1974	1,423	+13.4	3.5	+20.7
1975	1,435	+0.8	3.8	+8.6
1976	1,498	+4.4	4.0	+5.3
1977	1,582	+5.6	4.0	—
1978	1,679	+6.1	3.7	-7.5
1979	1,976	+17.7	3.8	+2.7
1980	2,383	+20.6	4.1	+7.9
1981	2,728	+14.5	4.4	+7.3
1982	3,007	+10.2	4.5	+2.3
1983	3,493	+16.2	4.8	+6.7
1984	3,817	+9.3	5.0	+4.2
1985	3,883	+1.7	5.0	—
1986	4,107	+5.8	5.3	+6.0

Notes: EMC cautions information is subject to error. Figures do not include the University of Puerto Rico. Statistics for minorities not available before 1973. Data includes figures for Hispanics other than Mexican Americans and Puerto Ricans.

Derived from: Reports, bulletins and publications of the Engineering Manpower Commission (EMC).

■ **Appendix F-1**

Minority Engineering Enrollment Data

Analysis of Tables 1, 2, and 3

- a 371% increase in the number of minority freshmen enrolled full time in engineering occurred between '73 and '85—an average annual growth rate of 13.8%;
- a 136% increase in the minority percentage of all freshmen enrolled full time in engineering occurred between '73 and '85—an average annual growth rate of 7.4%;
- total full-time freshman enrollment in engineering increased by 100% from '73 to '85—an average annual growth rate of 5.9%;
- a 331% increase in the number of minority students enrolled full time in engineering occurred between '73 and '85—an average annual growth rate of 12.9%;
- a 102% increase in the minority percentage of all students enrolled full time in engineering occurred between '73 and '85—an average annual growth rate of 6.1%;
- total full-time enrollment in engineering increased by 107% from '73 to '85—an average annual growth rate of 6.2%;
- a 227% increase in the number of minority engineering graduates occurred between '73 and '86—an average annual growth rate of 9.5%;
- a 83% increase in the minority percentage of engineering graduates occurred between '73 and '86—an average annual growth rate of 4.7%;
- total engineering graduates increased by 81% from '73 to '86—an average annual growth rate of 4.7%.

■ **Appendix F-2**

Academic Preparedness of High School Students

■ **Table 1:** Average SAT Scores by Race/Ethnic Group and Performance Gaps

Year	White	Black	W/B Gap	Mexican American	W/M Gap	Puerto Rican	W/PR Gap	American Indian	W/AI Gap
1976	944	686	-258	781	-163	765	-179	808	-136
1977	937	687	-250	778	-159	752	-185	811	-126
1978	931	686	-245	772	-159	737	-194	806	-125
1979	927	688	-239	780	-147	733	-194	807	-120
1980	924	690	-234	785	-139	744	-180	816	-108
1981	925	694	-231	788	-137	751	-174	816	-109
1982	927	707	-220	793	-134	763	-164	812	-115
1983	927	708	-219	792	-135	762	-165	813	-114
1984	932	715	-217	796	-136	766	-166	817	-115
1985	940	722	-218	808	-132	777	-163	820	-120

Derived from: **Professional Women and Minorities: A Manpower Data Resource Service** (Commission on Professionals in Science and Technology: Washington, D.C., February 1986), Table 1-5, p. 10.

Analysis

- the SAT performance gap between White and Black students has been reduced by 15.5% between '76 and '85—17.3% on Math section and 13.4% on Verbal section;
- the SAT performance gap between White and Mexican-American students has been reduced by 19.0% between '76 and '85—21.9% on Math section and 16.3% on Verbal section;
- the SAT performance gap between White and Puerto Rican students has been reduced by 8.9% between '76 and '85—10.9% on Math section and 6.9% on Verbal sectin;
- the SAT performance gap between White and American Indian students has been reduced by 11.8% between '76 and '85—13.7% on Math section and 9.5% on Verbal section.

■ **Appendix F-2**

Academic Preparedness of High School Students

■ **Table 2:** Changes in Mean Performance on the Mathematics Assessment by Race/Ethnic Group and Age

Race/Ethnic Group and Age	Overall Perform. Score (1982)	Overall Perform. Change '78-'82	Knowledge Score (1982)	Knowledge Change '78-'82	Skills Score (1982)	Skills Change '78-'82	Understanding Score (1982)	Understanding Change '78-'82	Applications Score (1982)	Applications Change '78-'82
Total										
9-year-olds	56.4%	+1.0%	68.3%	+1.4%	50.6%	+0.8%	41.2%	-0.4%	39.6%	+0.5%
13-year-olds	60.5	+3.9	73.8	+4.5	57.6	+4.0	60.5	+3.9	45.6	+2.2
17-year-olds	60.2	-0.2	74.9	+0.2	60.0	+0.3	61.5	-0.3	42.4	-1.1
White										
9-year-olds	58.8	+0.7	70.8	+1.2	53.1	+0.6	43.4	-0.8	42.4	+0.6
13-year-olds	63.1	+3.2	76.1	+3.9	60.4	+3.4	63.6	+3.6	47.9	+1.6
17-year-olds	63.1	-0.2	77.3	0.0	63.0	+0.3	64.7	-0.1	45.5	-1.0
Black										
9-year-olds	45.2	+2.1	57.8	+3.5	38.7	+1.6	31.4	+0.9	27.0	-0.6
13-year-olds	48.2	+6.5	63.8	+8.0	44.0	+6.7	46.4	+5.9	34.8	+4.4
17-year-olds	45.0	+1.3	62.6	+3.0	44.2	+1.8	44.8	-0.2	26.0	-0.2
Hispanic										
9-year-olds	47.7	+1.1	58.7	0.0	43.8	+2.5	32.4	-0.2	30.5	+0.6
13-year-olds	51.9	+6.5	65.3	+6.3	49.2	+7.2	49.7	+5.9	38.8	+6.0
17-year-olds	49.4	+0.9	66.1	+2.0	48.4	+0.5	49.7	+0.8	31.4	+0.4

Change is significant at 0.05 level.

Source: **Professional Women and Minorities: A Manpower Data Resource Service** (Commission on Professionals in Science and Technology: Washington, D.C., February 1986), Table 1-2, p. 7.

Analysis

- Black students surpassed White students in change in overall performance at each age level; Black 13-year-olds surpassed their White counterparts in change in all four test components; and Black 9-year-olds and 17-year-olds surpassed their White counterparts in change in three of the four test components.
- Hispanic students surpassed White students in change in overall performance at each age level; both the 13-year-old and the 17-year-old Hispanic students surpassed their White counterparts in change in all four test components; and the Hispanic 9-year-olds surpassed their white counterparts in three of the four test components.

■ **Appendix F-2**

Academic Preparedness of High School Students

■ **Table 3:** Enrollment Status Percentage of Persons 16-24 Years Old by Race/Ethnic Group

Enrollment Status	Total		White			Black			Hispanic		
	1981	1985	1981	1985	% Chge.	1981	1985	% Chge.	1981	1985	% Chge.
Enrolled	43.1	44.3	42.8	44.3	+3.5	42.2	41.7	-1.2	36.6	36.8	+0.5
Not Enrolled	56.9	55.7	57.2	55.7		57.8	58.3		63.4	63.2	
Completed High School	31.0	43.3	31.4	43.7	+39.2	30.4	43.4	+42.8	23.6	35.7	+51.3
Completed College	4.1	4.6	4.5	4.9	+12.2	1.8	2.0	+11.1	1.3	2.0	+53.8

Derived from: **Professional Women and Minorities: A Manpower Data Resource Service** (Commission on Professionals in Science and Technology: Washington, D.C., February 1986), Table 1-13, p. 15.

■ **Appendix F-2**

Academic Preparedness of High School Students

■ **Table 4:** Percent of 1980 and 1982 High School Seniors Who Took Math and Science Courses in Grades 10-12 by Race/Ethnic Group

Subject	White	Black	Hispanic	American Indian
Advanced Algebra	9.0	5.1	3.0	1.8
Geometry	53.4	33.3	28.4	23.9
Trigonometry	8.3	3.6	4.6	3.6
Other Advanced Math	15.4	5.4	7.0	4.5
Calculus	6.4	2.0	2.4	2.0
Basic Biology	75.4	74.1	69.1	65.4
Advanced Biology	9.3	5.7	4.6	6.3
Other Biology	0.7	1.2	0.6	1.0
Chemistry I	26.8	18.6	12.9	30.4
Advanced Chemistry	4.4	2.2	1.7	2.1
Other Chemistry	7.8	5.7	3.3	19.8
Physics	12.9	5.5	4.9	7.1
Advanced Physics	1.6	1.1	0.5	0.0
Other Physics	4.2	1.9	1.2	6.0
Biochemistry/Biophysics	0.3	0.0	0.1	0.4

Source: **Professional Women and Minorities: A Manpower Data Resource Service** (Commission on Professionals in Science and Technology: Washington, D.C., February 1986), Table 1-7, p. 12.

■ **Appendix F-2**

Academic Preparedness of High School Students

■ **Table 5:** Percentages of College Freshmen Who Earned an "A" Average in High School by Selective Racial/Ethnic Grouping and Probable Major Field of Study: 1983

	Total	White	Black	Hispanic	American Indian
All College Freshmen	27.6	29.4	10.1	28.4	23.1
Science and Engineering	36.4	38.1	16.5	39.1	29.3
Physical Science	48.3	48.5	31.9	46.7	50.0
Mathematics	51.1	52.7	26.8	26.9	27.9
Engineering	41.6	42.6	23.9	50.3	41.5
Non Science-Engineering	23.5	25.3	7.2	22.7	20.7

Note: The population is defined as first-time, full-time, college freshmen in four-year colleges and universities.

Derived from: **Women and Minorities in Science and Engineering** (National Science Foundation: Washington, D.C., 1986), Appendix Table 45, p. 163.

■ **Table 6:** Average SAT Mathematics Scores of College-Bound Seniors by Intended Area of Study and Racial/Ethnic Groupings: 1984

	Total	White	Black	Mexican American	Puerto Rican	American Indian
Total	466	483	362	415	398	425
Majors						
Physical Science	565	571	418	498	455	508
Mathematics	584	591	407	499	527	495
Engineering	541	555	416	480	464	500

Derived from: **Women and Minorities in Science and Engineering** (National Science Foundation: Washington, D.C., 1986), Appendix Table 44b, p. 162.

■ **Appendix G**

Program Budget

	Direct Expenses						Indirect Expenses	
Activity	**Salaries/ Benefits**	**Travel**	**Instructional Materials**	**Office Supplies**	**Equipment**	**Other Expenses**	**Rent**	**Other Expenses**
Student Components								
Counseling/Advising	$____	$____	$____	$____	$____	$____	$____	$____
Parental Involvement	____	____	____	____	____	____	____	____
Role Modeling	____	____	____	____	____	____	____	____
Student Achievement Recognition	____	____	____	____	____	____	____	____
Student Projects	____	____	____	____	____	____	____	____
Summer Programs	____	____	____	____	____	____	____	____
Teacher/Curriculum Improvements	____	____	____	____	____	____	____	____
Tutoring	____	____	____	____	____	____	____	____
Subtotal	$____	$____	$____	$____	$____	$____	$____	$____
Management	____	____	____	____	____	____	____	____
Fund Raising	____	____	____	____	____	____	____	____
Other Services								
Audit						____		
Insurance						____		
Equipment Maintenance						____		
Telephone/Utilities						____		
Postage						____		
Subtotal						$____		
Grand Total	$____	$____	$____	$____	$____	$____	$____	$____

■ Appendix H

Proposal Writing Format*

I. Proposal Summary

The summary is probably the first thing that a funding source will read. It should be clear, concise, and specific. It should identify who you are, the scope of your project, and the projected cost. The summary may be presented as a cover letter.

Some funding sources may screen proposal summaries as a first step to determine if a program is consistent with their priorities, if it is from an entity eligible to apply for their funds, etc.

II. Introduction

In this section, you build your credibility as an organization that merits the foundation's support. Identify yourselves, your organization, and the authors of your proposal.

Points you might want to include:

- your organizational goals—why you initiated the program
- how the organization got started
- how long you've been in existence
- your most significant accomplishments, or if you're a new program, some significant accomplishments of your board or staff members; include the resumes of key staff members in the appendix
- the support you've received from other organizations and individuals; include letters of endorsement in the appendix

III. Program Statement or Assessment of Need

Zero in on the specific problem you are addressing with your program and document it. Cite recognitions of the problem by influential organizations and individuals.

Include evidence to support the existence of the problem, but do not overuse statistics. If you have extensive data, put it in the appendix.

Demonstrate your organization's unique ability to create an effective intervention for the targeted population.

Explain why resolving the problem or alleviating it is in the funding organization's interests and why your enterprise is one they would be glad to be part of.

IV. Program Objectives

State succinctly how you plan to address the problem you've defined by listing specific objectives and measurable outcomes for program activities.

For educational programs, delineate student performance objectives—the desired level of performances, behaviors, or other end products to be achieved by the students, and your process objectives—the means by which student performance objectives and process goals are to be achieved. (See Operational Plan in Chapter Five and Appendix I.)

V. Methods

Describe the methods you'll use to accomplish your objectives, why you've chosen them, and why you think they'll work.

Considering alternatives is an important aspect of describing your methodology. In discussing various methods, you might want to mention the way they've been employed elsewhere and the results. Show that you're sufficiently familiar with your field to be aware of different models for solving the problem. Express your reasons for selecting the model you've chosen to enhance your credibility and give the funding source the confidence that you know what you're doing.

VI. Evaluation

Evaluation serves two purposes for your organization: it determines your program's effectiveness in reaching the objectives you've established, and provides information necessary to make changes and adjustments in your program as it proceeds.

By establishing measurable objectives for your program, and laying them out for your funding source in your grant proposal, you set the stage

for an effective evaluation for yourselves as well. While subjective evaluations—how people feel about a program—are very important in assessing the program's quality, funding sources are more interested in truly objective evaluations that result in quantifiable assessments.

VII. Future Funding

If your request for funding is not for ongoing support, explain how you will continue to finance your program in the future. Present a plan that assures the funding source, to the greatest extent possible, that you'll be able to maintain your program after their grant has expired.

VIII. Budget

The last section of your proposal, excluding appendices, is an itemized budget of total projected expenditures. If you're requesting a specific amount from the funding source, you should also itemize how those funds will be spent if awarded. Budget items should clearly correlate with program activities outlined in previous sections of the proposal. Budget notes can be used to explain items that might be unclear. In-kind contributions by the applicant organization and others might also be included in the appropriate budget item to illustrate that you're not relying completely on a single funding source.

Notes:

Take special care in writing proposals to ensure a logical flow from one section to another. If you use appendices, refer to them in the body of the proposal.

Some funding sources may have their own formats which you should follow.

*This outline was derived from "Program Planning and Proposal Writing" by Norton J. Kiritz, in **The Nonprofit Organization Handbook**, Tracy D. Connors, Editor in Chief (McGraw-Hill Book Company: New York, 1980).

■ **Appendix I**

Developing an Operational Plan: Definitions and Illustrations

Organizational Goals are very broad statements telling what the organization plans to achieve. Goals are timeless in nature and are not measurable as stated. In an educational setting, goals should be small in number and can be outlined as student performance goals and process goals.

■ **Student Performance Goals** are statements which express exactly what the organization plans for the participating students to achieve.

■ **Process Goals** are statements which articulate the administrative and instructional functions required to attain the student performance goals; and other operations necessary for the perpetuation of the organization.

Organizational goals for a comprehensive precollege minority engineering program might be written in the following manner:

Student Performance Goals

I. Increase participating students' awareness and understanding of opportunities and motivation needed for the study of engineering and related areas at the post-secondary level.

II. Increase participating students' academic preparedness to pursue the study of engineering or some related field at the post-secondary level.

III. Increase participating students' motivation to pursue the study of engineering or some related field at the post-secondary level.

IV. Increase the number of underrepresented minorities who complete high school in the Crawfordville area and successfully pursue the study of engineering or some related field at the post-secondary level.

Process Goals

I. Achieve and maintain the enrollment level consistent with organizational plan.

II. Conduct comprehensive needs assessment of participating students' academic skills and motivation.

III. Provide effective and efficient administration of program's enrichment components.

IV. Engage qualified staff of employees and volunteers, and provide them with training to enhance their services to students.

V. Orient various constituencies to program mission/philosophy, goals and objectives, work and activity situations, procedures, rules, regulations, responsibilities, expectations and standards.

VI. Develop and submit annual budget(s) to governing body, and manage approved budget(s) as prescribed.

VII. Establish and maintain office policies, manage office procedures, maintain program files, publications, etc.

VIII. Establish and maintain positive relations with constituencies, promote public awareness and appreciation of program activities and achievements, and advocate further growth and development of effective program activities.

IX. Assure availability and use of collaborating organizations' and others' facilities required to deliver program services.

X. Conduct fund-raising campaign to support program acitvities.

XI. Evaluate effectiveness of program activities and re-design or replace features that fail to effect desired results.

XII. Report on evaluation; report on short-term and long-range plans to organizational membership and/or governing body, in a thorough fashion, at prescribed times.

Note: Each organizational goal is subsequently defined by a number of organizational objectives that specify how each goal is to be attained.

Organizational Objectives are specific statements telling what the organization plans to achieve. Just like goals, objectives are written for both student performance and organizational process.

■ **Student Perfomance Objectives** are detailed specifications for each individual student performance goal that include educational and/or behavioral objectives stated in measurable terms

that specify what the learner will be expected to achieve or do.

The elements of a well written student performance objective are:

1. time frame
2. target group
3. expected behavior
4. proficiency level
5. by what measurement

■ **Process Objectives** are detailed specifications of individual student performance goals as well as process goals. Process objectives are the most definitive subdivision of an operational plan. They itemize the administrative, instructional and/or support activities designed to attain the organizational goals.

The elements of a well written process objective are:

1. activity (action steps)
2. timetable
3. individual(s)/group(s) responsible and other resources
4. documentation

Corresponding to the organizational goals presented above, organizational objectives for a comprehensive precollege minority engineering program might be written in the following manner:

Student Performance Goal

II. Increase participating students' academic preparedness to pursue the study of engineering or some related field at the post-secondary level.

Student Performance Objectives

A. By the end of each program year, all of the participating students will have demonstrated a heightened academic preparedness to pursue the study of engineering or some related field, as measured by their enrollment in and successful completion of a college preparatory course of study appropriate for or in advance of their individual grade levels.

B. By the end of each program year, 75% of the participating students will have demonstrated a heightened academic preparedness to pursue the study of engineering or some related field, as measured by their achievement or maintenance of at least a 3.0 GPA in a prescribed course of study at their secondary schools.

C. By the end of each program year, 75% of the participating students will have demonstrated a heightened academic preparedness to pursue the study of engineering or some related field, as measured by their achievement of at least a 10% gain in their scores on PSAT's over their respective scores the previous year.

Note: Each student performance objective would be followed by at least one process objective that details how that performance is to be achieved. Process objectives for student performance goals follow the same format as those for process goals, illustrated below:

Process Goal:

I. Achieve and maintain the enrollment level consistent with organizational plan.

Process Objectives:

A. By the end of December, administrative staff (AS) will have designed or revised Student Identification, Recruitment and Selection (SIRS) processes as documented by file copies of SIRS forms and procedural outlines, and sectional Administrative Log entries, employing the following action steps:

1. Given the scope of available program resources, determine the parameters of what services can be effectively and efficiently provided to program students.
2. Develop or revise procedures for the identification, recruitment and selection of student participants—SIRS.
3. Develop or revise data and information gathering forms and publications for SIRS procedures.
4. Arrange for the printing/duplication of SIRS forms and publications.
5. Orient office staff as to the management of SIRS procedures and record keeping responsibilities.

B. By the end of January, AS will have identified at least 150 minority students at each target JHS potentially interested and/or academically able to pursue a college degree in engineering or some other math/science based field, as documented by file copies of teacher/counselor referrals (FORM SIRS

101) and sectional Administrative Log entries, employing the following action steps:

1. Meet with math and science teachers and guidance counselors at each target JHS and explain:
   a. program components, student performance goals and objectives,
   b. SIRS procedures,
   c. profile of students to be identified by school personnel, and
   d. identification procedures, timetables and roles of school personnel.
2. Collect FORM SIRS101 from school personnel.
3. Review information on referred students and determine eligibility of individual students.
4. Compile from SIRS101s a roster of eligible students for each JHS.
5. Prepare student recruitment packages for distribution to students by guidance counselors.

C. By the end of February, AS will have contacted all students identified by target school personnel and the students' parents/guardians via recruitment package, as documented by sectional Administrative Log entries and file copy of recruitment package. Recruitment package will consist of:

1. Letter explaining why and how student was referred to program,
2. Program brochure detailing program components and student performance goals and objectives,
3. Invitation to students and parents/guardians to address any questions to program administrators, and
4. Invitation to students to register with guidance counselor for a program introduction and student application presentation.

D. By the end of May, AS will have admitted 50 targeted students from each JHS to the program, as documented by individual student files and sectional Administrative Log entries, employing the following action steps:

1. Make program introduction and student application presentation to interested students at each target JHS, consisting of the following:
   a. elaborations on program components, student performance goals and objectives,
   b. question and answer period,
   c. explanation of application and selection process, procedures and timetables,
   d. instruction on completing and filing student application, and
   e. questions and answers.
2. Review completed student applications.
3. Review student applicants' school transcripts.
4. Consult with school personnel regarding student applicants.
5. Make admission decisions and notify all applicants, their parents/guardians, guidance counselors and school administrators—place all nonadmitted students on admission waiting list.

Evaluation Plan, the final section of an Operational Plan, consists of detailed statements telling what the organization will assess, how it will be done, and how the organization will use the results of the assessment.

Evaluation is the process of measuring program outcomes against goals and objectives in order to provide specific information which can be used in problem solving, decision making, achievement assessment and future planning and implementation.

- **Formative Evaluation** is conducted during program operation so that immediate feedback can be provided and appropriate changes made, and is especially important during the initial implementation of program activities.

- **Summative Evaluation** is conducted after the completion of a process or activity so that judgments and comparisons can be made of its effectiveness.

Note: A sample recording format for an operational plan follows:

■ Appendix I

Crawfordville Area Program for Minorities in Engineering

■ Operational Plan Using an MBO Format

Student Performance Goal: II. Increase participating students' academic preparedness to pursue the study of engineering or some related field at the post-secondary level.

Process Objectives

Student Performance Objective	Action Steps	Timetable	Resources (Personnel)	Documentation	Evaluation Plan
By the end of each program year, all participating students will have demonstrated a heightened preparedness to pursue the study of engineering or some math/science-based field, as measured by their enrollment in and completion of a college preparatory course of study appropriate for or in advance of their individual grade levels.	During course registrations at the target schools, Program Advisors (PAs) will ensure that participating students enroll in the appropriate courses for next school year, employing the following action steps, as documented by program's Course Registration Forms (CRF): ■ review each student's program file and transcript. ■ develop recommendations for course selections given student's academic performance and college aspirations, and staff evaluations. ■ communicate recommendations to student and his/her parents.	Feb. 1-May 15	PAs	Annual CRFs in individual student files.	During process, Administrative Staff (AS) will assess effect of process via feedback from PAs. At the end of process, AS will review all CRFs and action steps and assess process effectiveness. AS will make revisions in process and/or personnel as indicated by PA feedback and CRFs.

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